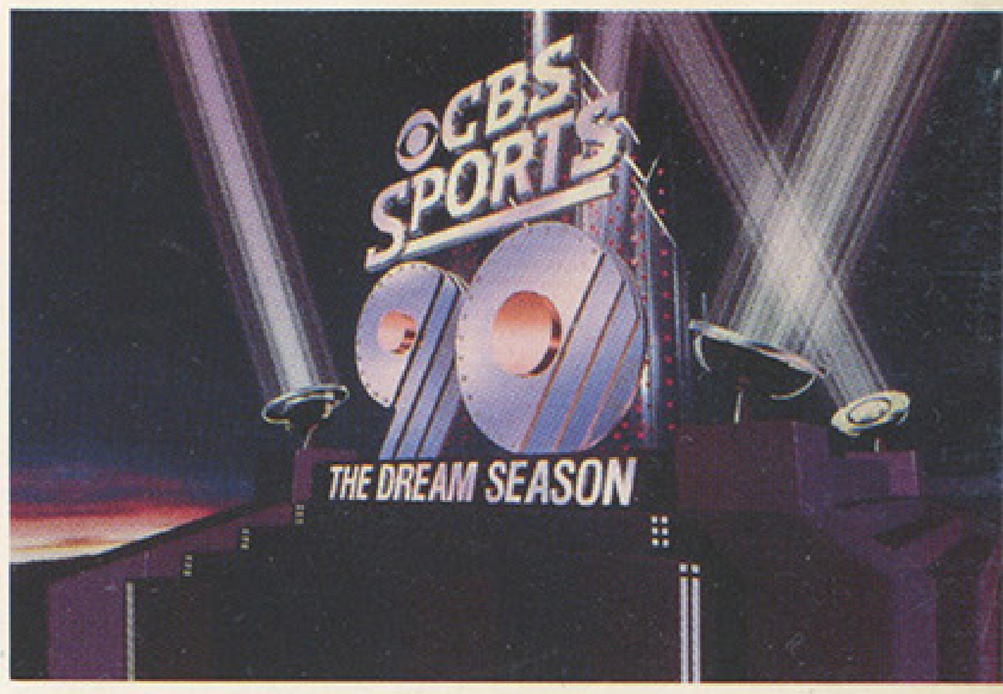

getting started with Alias

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Alias Research Inc.

Second Edition
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© 1989, 1990 Alias Research Inc.
110 Richmond St. East
Toronto, Ontario
Canada M5C 1P1
(416) 362-9181
Alias Assist: (416) 362-8670
Canada and continental U.S.A. only: 1-800-465-0868

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What this Manual Will Do For You

Welcome to the Alias solution. You are about to discover the power and the potential that ALIAS opens up for you. This guide provides you with the concepts behind ALIAS, an overview of the system, its options, and its documentation. It answers your questions like, "What is that, what does it do, and what can it do for me?" It also contains easy to understand, easy to use instructions on everything from creating your design to presenting it. That is to say, everything that you will need to know to Get Started With ALIAS.

This guide also provides you with materials to prepare you for ALIAS training. ***Getting Started*** equips you with the background you need, so you'll be able to get the most out of the time you spend both learning to use and master your ALIAS System.

Our primary goal at Alias is to make our products highly productive by making them easy to learn, easy to use, and powerful. This guide is one step towards this goal. As you read through it, you'll discover more and more of the power and creativity built into ALIAS. We believe that the ALIAS solution is the best solution for you.

The ALIAS Solution

Computer Jargon

Hardware

A computer is a machine that can do many things you can, but often it can do them faster and more accurately. It relies on you, the user, to tell it what to do. It has a brain called the processing unit where it processes your instructions. It has ears: the keyboard and mouse (also called input devices) that allow you to communicate your needs to the processing unit. And it has a mouth — the monitor or screen or output device — which is the computer's way of communicating back to you what you instructed it to create.

The great thing about ALIAS is that the computer can not only show you the results of your instructions, but it can comunicate with other computers that can actually build your design (called CAD/CAM systems).

A computer can't do anything without a program or software. That's the secret of getting a computer to perform the task you desire, whether it be designing a box, a car, or creating your own animation.

Software

Software, on the other hand, includes the information contained on:

- a software tape,
- floppy disk,
- or compact disk,

which tells the computer what to do with its hardware. ALIAS is software. It's as though the software is the computer's thoughts, and the hardware its brain. You could also say that the software runs on the hardware.

What can ALIAS software do for you?

ALIAS software is the ability to model anything, quickly, in three dimensions, and to simulate movement in a 3D world.

ALIAS software also allows you to create a design that is so accurate you can manufacture your ideas by communicating your design to another computer that specializes in that task.

ALIAS not only helps you create images in three dimensions, but you can bring in real life materials, textures, etc., enabling you to visualize your creation in the most lifelike of environments.

Bits, Bytes and Megabytes

A computer has a very basic and limited vocabulary. In fact, it can understand only two signals that correspond to *off* and *on*, and are traditionally represented as "0" and "1." This means that all the information that goes into a computer is translated into patterns of "0s" and "1s" so the computer can read it.

Megabyte

Each "0" or "1" is called a *bit*. A bit is the smallest piece of information that a computer can store or retrieve. A group of eight bits is called a *byte*. It takes approximately one byte to store one character of text. We usually refer to the capacity of a computer's memory in terms of bytes: for example, a computer that has one *megabyte* of memory can remember one million bytes' worth of information. The common abbreviation for megabytes is *Mb*. Ten megabytes is written as 10 Mb. Bits, bytes, and megabytes apply to both short-term and long-term memory.

Memory The computer's memory works in much the same way as the human memory. It has a short-term memory that contains any temporary data that the computer may need for its own internal work, and a permanent memory that contains data you've created, the operating system, and the ALIAS program.

Short Term Memory When the power is shut off, everything in the short-term memory is lost, and it must be re-loaded the next time that the computer is turned on. This memory is usually referred to as *RAM* (random access memory). However, should you wish to save something more permanently (e.g., for future reference), you can do so by saving it in the long-term memory.

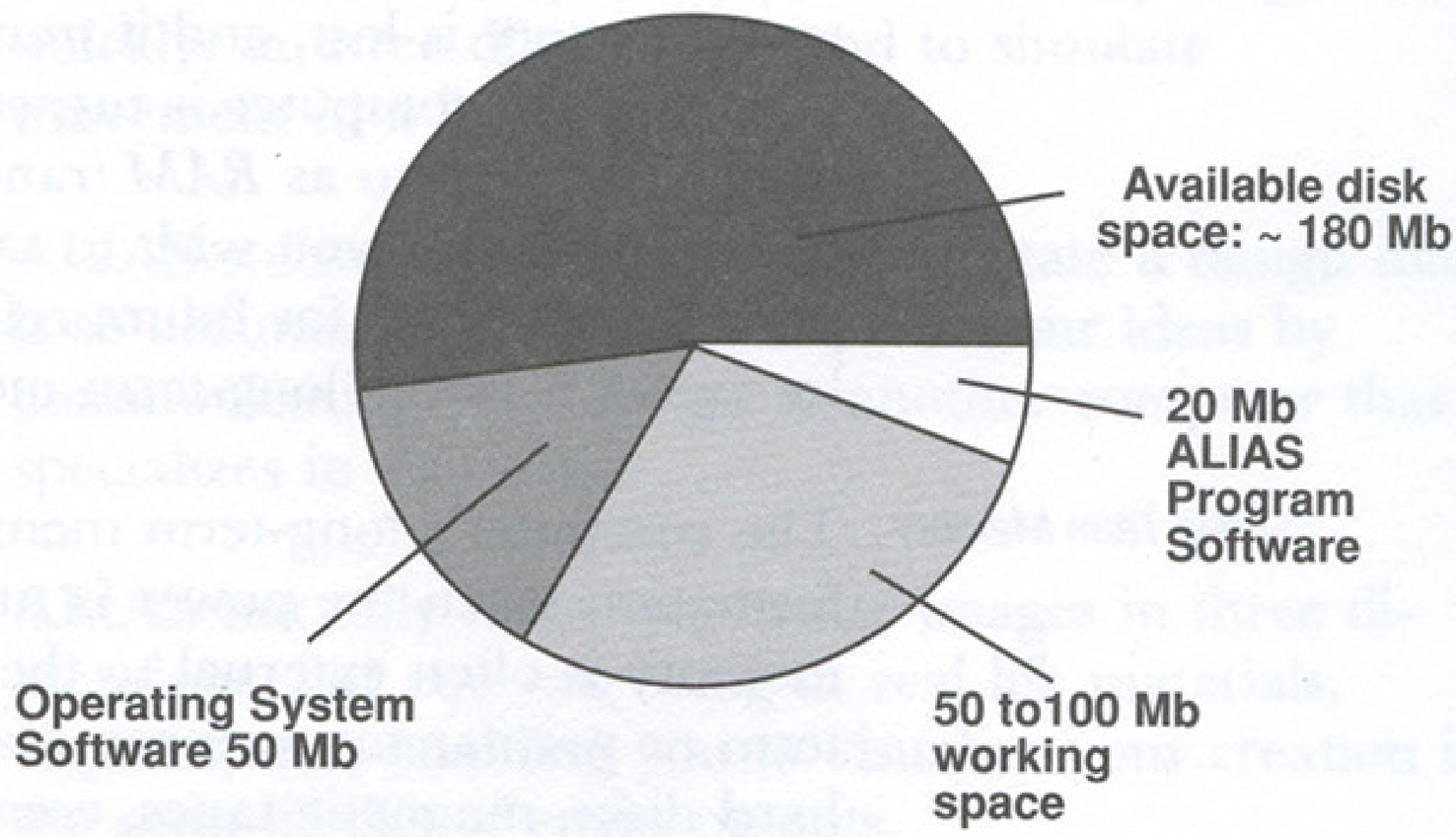
Long Term Memory The computer's long-term memory does not lose its information when the power is turned off. This type of memory is often external to the computer itself. Long-term or permanent memory may exist in the form of hard disks, magnetic tapes, compact disks, or floppy disks. ALIAS uses hard disks and magnetic tape. The total amount of memory on a hard disk is usually referred to as *storage capacity* or *disk capacity*.

Storage The hard disk is a device for storing large amounts of information. It is very easy to quickly retrieve information from a hard disk, which makes it ideal for storing the geometry and pictures that you can create with ALIAS.

Disk Space Disk space is the available space on the hard disk. *Free disk space* refers to the amount of room left on the hard disk for storage of files.

Hard Disk Allocation When your system arrives, it has nothing but the operating system on the hard disk. Once ALIAS software is loaded, a standard system with a single 380 megabyte disk drive would have approximately 180 Mb left free.

The remaining hard disk space in your ALIAS system will be used to store the operating system, the ALIAS software, and your work. A certain amount of space will also be used up for "working space" for the computer. To give you an idea of the relative sizes of the files, if you had a 300 megabyte disk, your storage would be divided approximately as follows:



Peripheral Devices

Apart from the basic computer, ALIAS also links up with a wide variety of other devices, called *peripherals*, that expand your ability to communicate with ALIAS and your audience. A short listing of these peripherals appears below; for a more detailed discussion, please see the section on peripheral devices in *Computer Graphics Made Easy*.

- **Video Integration**: The ability to bring existing videotaped images into ALIAS or to record ALIAS images and animations onto videotape. With ALIAS, you have your choice of either digital or analog video connections.
- **Image Scanning**: When you need to read existing drawings, photographs, or slides into ALIAS to use as backgrounds or textures, or as templates from which to "trace" your model.

- **Digitizing Tablets**: For accurate input of existing line drawings without time consuming measuring.

- **Stereo Viewing**: For enhanced visual presentation of electronic 3D images — visualize ideas with 3D glasses.

- **Stereolithography**: For easily creating physical plastic prototypes of your computer generated model without using conventional tooling or molds.

- **Plotting**: For precisely presenting your ideas on paper as the basis for blueprints or engineering drawings.

- **Color Hardcopy**: For presenting your great screen images on paper in full color.

- **Film Integration**: Film scanners and film output: for presenting your screen images in the highest quality medium available — photographic film.

ALIAS is Computer Graphics Made Easy

ALIAS is a complete system that you use to quickly and easily generate professional three dimensional ideas. It' consists of a series of on-screen windows, menus, and pop-ups, providing you with hundreds of tools for creating, editing, displaying, animating, coloring, lighting, and presenting your work in an easy to understand three dimensional environment.

This chapter will lead you through each area of ALIAS, and will give you an idea of the tools you have at your disposal to create a finished product.

Modeling

A computer generated model in three dimensions communicates your ideas faster and more precisely than a sketch on a drawing pad. Modify your original draft quickly and easily, because you don't have to restart from scratch. Your ideas are always alive and ready to be changed if necessary. With ALIAS modeling, you truly get to shape your concepts and have them accurately interpreted down the road. It is the power of the ALIAS 3D database that information keeps your concepts alive and ready for change.

What is modeling?

What is modeling? A dictionary will tell you that it is the act of creating a three dimensional reproduction of something, usually on a smaller scale.

Additive and Subtractive Modeling

In the real world, there are basically two different techniques of creating a model: additive and subtractive. When working with clay, you use both additive and subtractive methods of modeling. First, you create the basic shape by adding clay in the appropriate places. To create detail, you might remove some of the clay that you used, and then add yet more clay, gradually working to a finer and finer scale.

How does this apply to computer modeling? As with clay, the two basic types of interactive computer modeling are additive and subtractive. You start a model by creating a basic shape (additive), stretch it and deform it, add to it, or cut pieces off of it (subtractive). Gradually working to finer details of the model, you add and subtract more pieces, and refine the details.

With ALIAS, instead of working with clay, you work with curves and surfaces in a simulated three dimensional environment. Imagine that you are working with wire: first you place wires that determine the basic shape of the object. By adding more wires to refine the specific shape and give it detail, you end up with a wire mesh that represents the shape. You then cover the wires with a skin of metal, cloth, or some other material. For the final step, you set up your lights and take a picture. This is essentially how ALIAS works.

Points and Control vertices

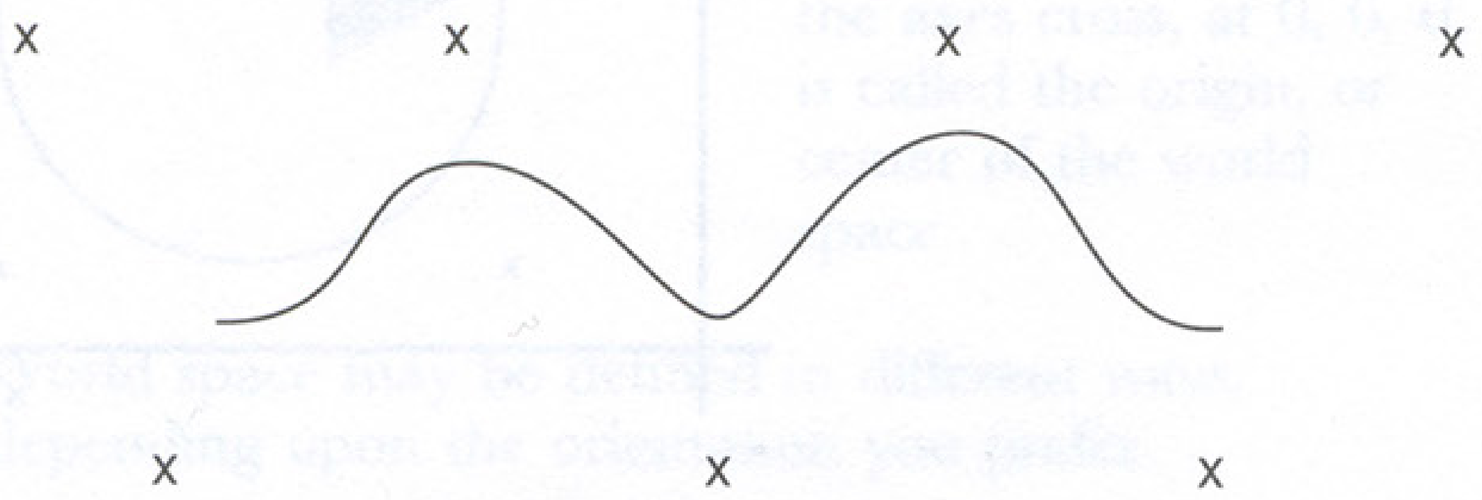
The basis for a computer model is the point. A point occupies no space: it serves as a place marker. With ALIAS, this marker is in three dimensions. Such markers are called *control vertices*, or CVs. Some ALIAS systems use an additional type of place marker, called edit points.

Splines

A series of CVs form a spline, which is a type of free-form line. Consider CVs to be similar to points on a graph: you plot the points, and ALIAS joins them with

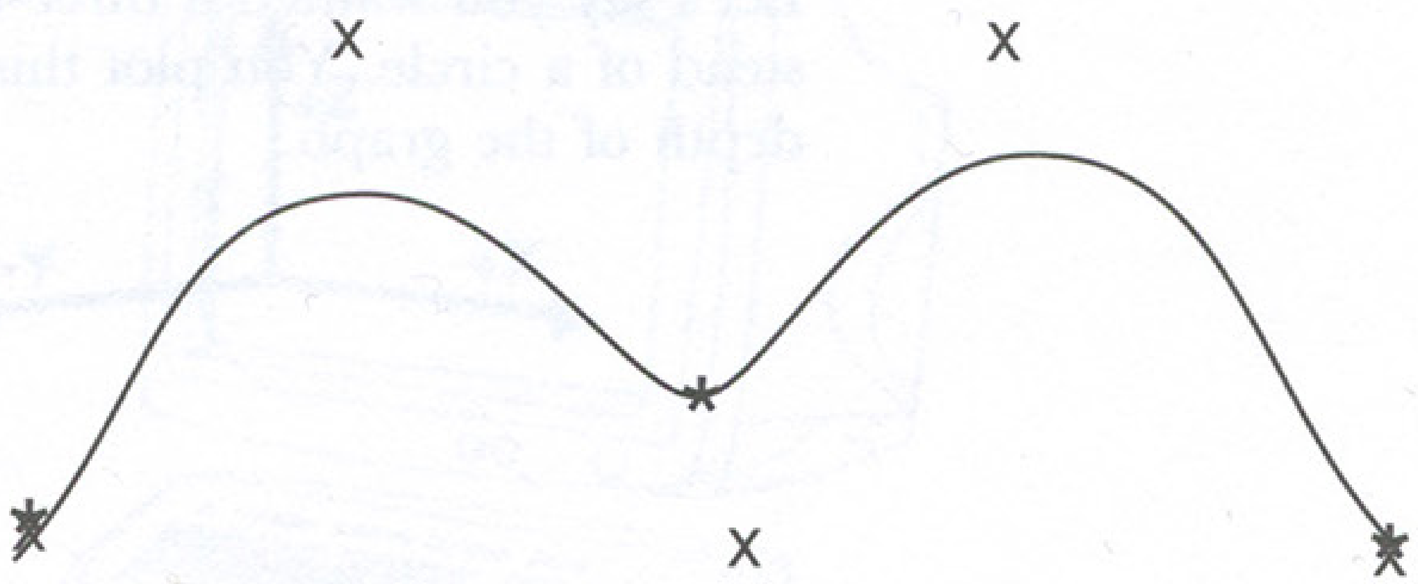
smooth lines. There are many different types of splines. The two most commonly used in ALIAS are b-splines and NURBS (non-uniform rational b-splines)

B-splines give smooth curves. On the following diagram, the x's mark the placement of the CVs:

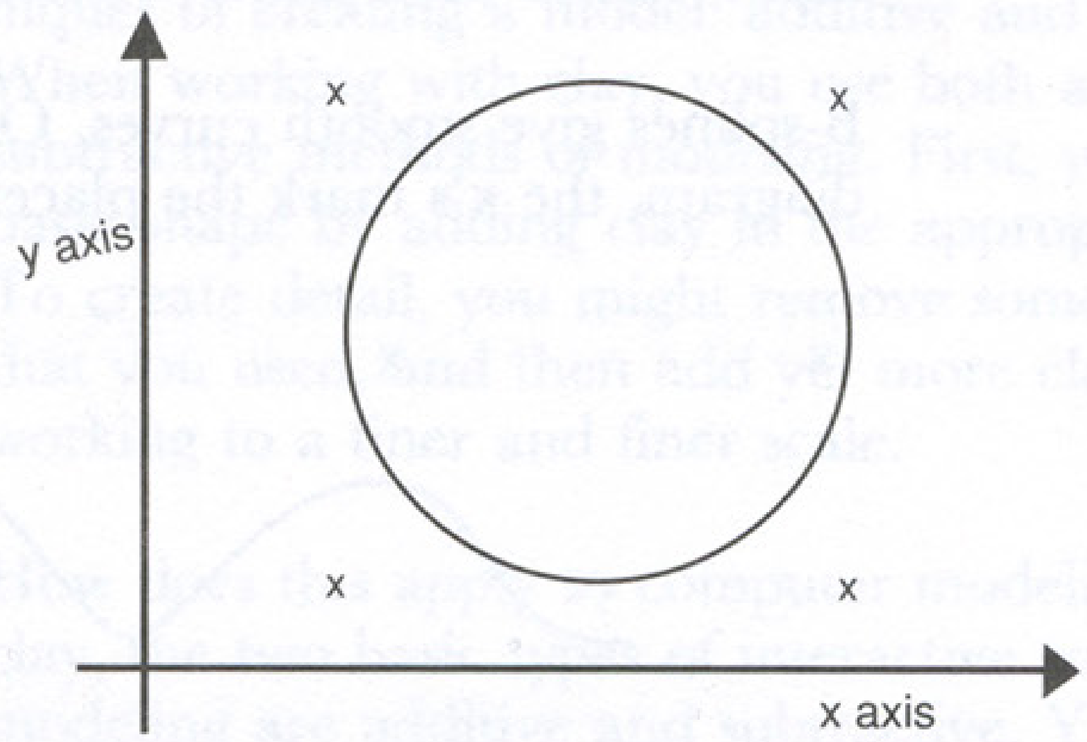


NURBS allow you to create and manipulate a curve from edit points placed directly on the curve. They also help Engineering Systems interpret your design more accurately.

Here's an example of how a NURBS looks. On the following diagram, the x's mark the placement of the CVs. Edit points, located on the curve itself, are marked with asterisks. The ends of the curve have both CVs and edit points. ALIAS NURBS connect, or *interpolate*, to the end points of the curve.



If you were plotting a circle, you could do it with as few as four points with a b-spline or a NURBS.



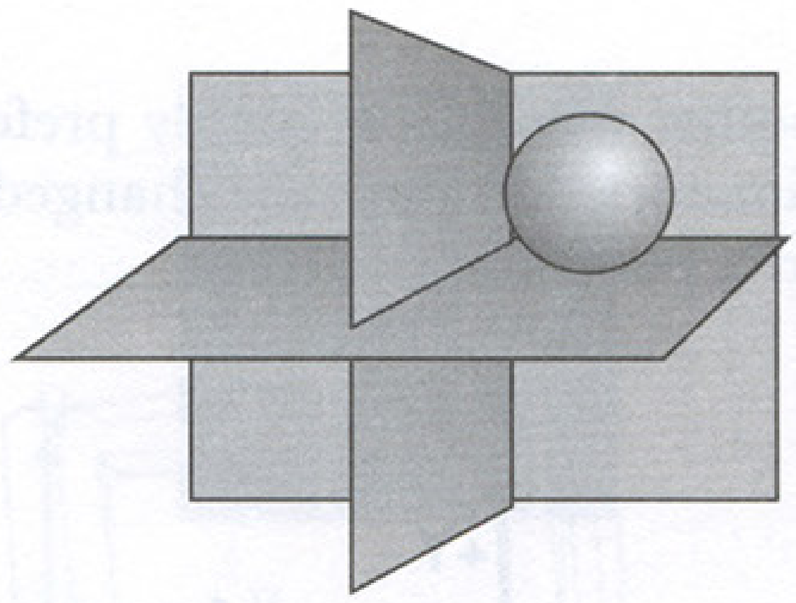
Two dimensions

A circle is a two-dimensional object. By convention, the horizontal axis is known as the x-axis, and the vertical axis as the y-axis, which make up the two-dimensional *coordinate system*.

Legend has it that Rene Descartes wanted to be able to represent things in three dimensions, and came up with the answer when he saw a fly buzzing around his room near the corner of the ceiling one night. He realized how he could describe the fly's position anywhere in the room: he introduced a third axis

Let's say you wanted a three-dimensional sphere instead of a circle. You plot this information across the depth of the graph.

Three-dimensional Coordinate System



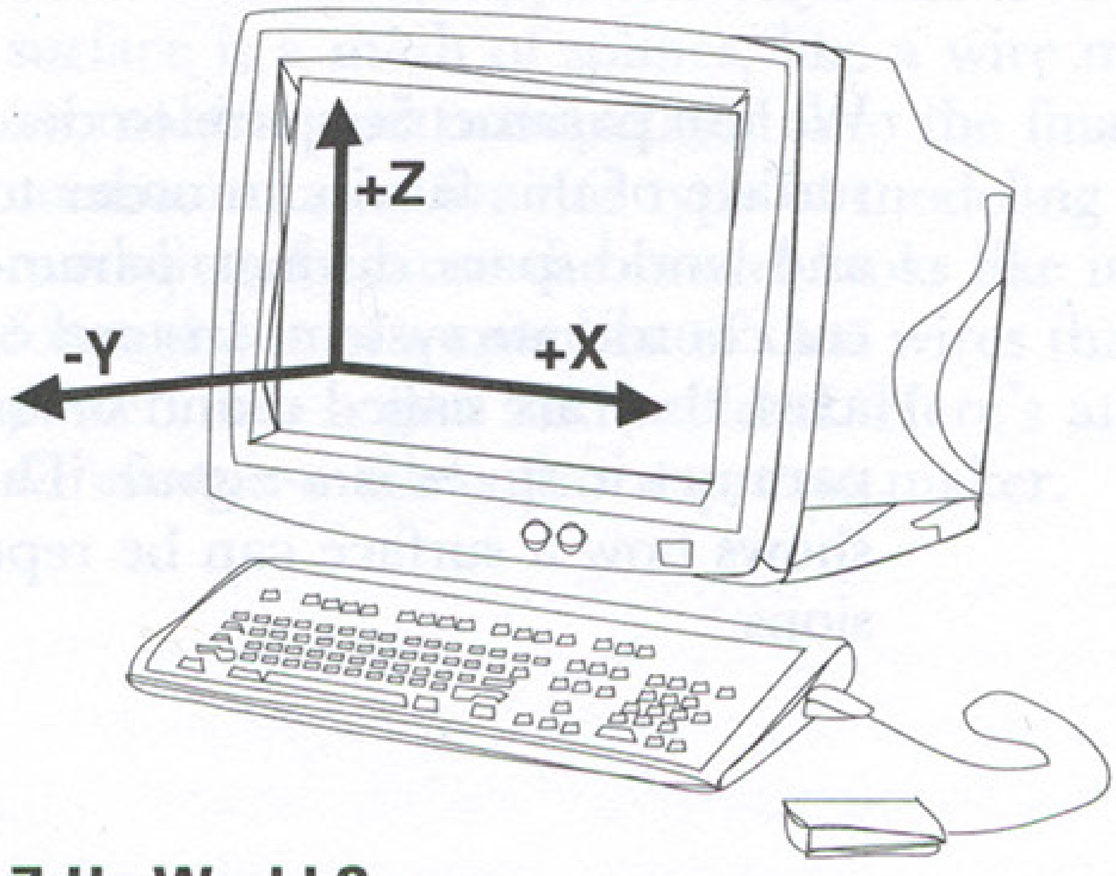
This third axis is conventionally called the z-axis. In computer graphics, these three dimensions make up what is commonly termed **world space**. The point where the axes cross, at 0, 0, 0, is called the origin, or center of the world space..

World Space

World space may be defined in different ways, depending upon the orientation you prefer.

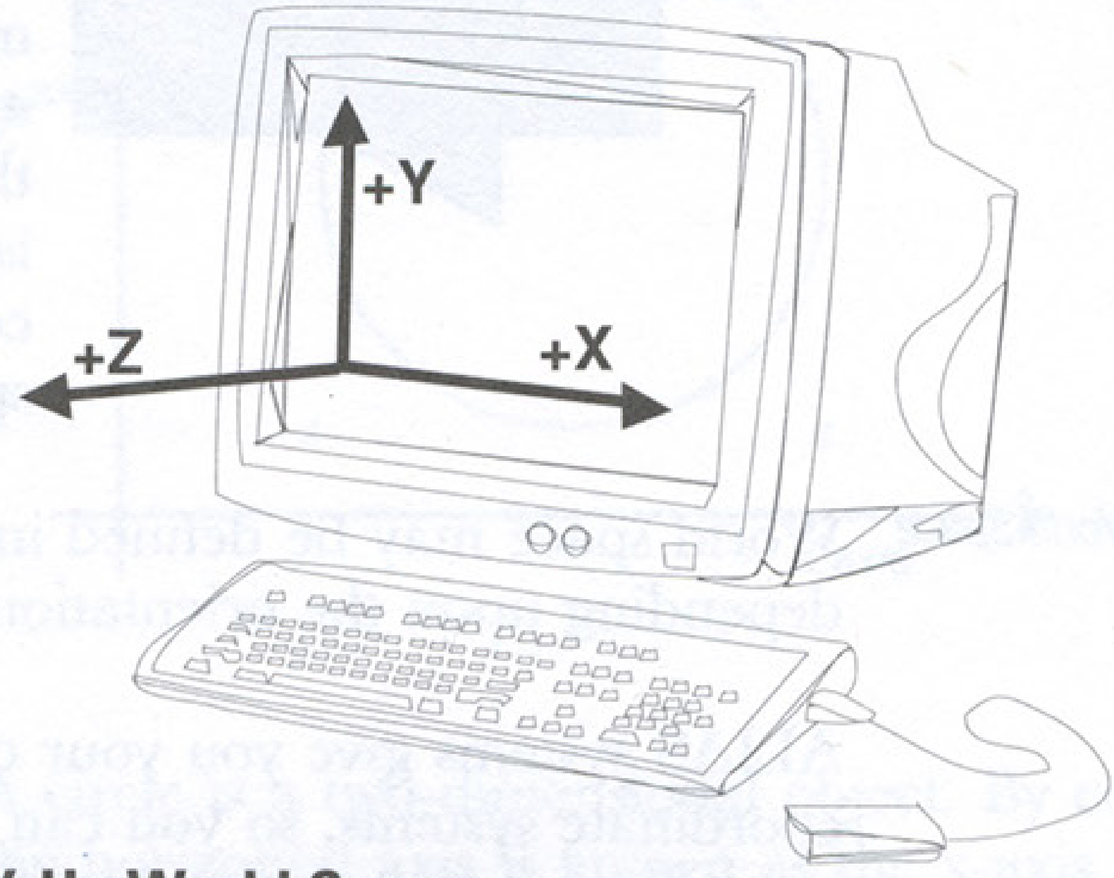
ALIAS systems give you your choice of world space coordinate systems, so you can work with whichever is most natural to you.

In one method, generally preferred by designers and engineers, the negative numbers for the z-axis are found below the point where the axes meet; for the x-axis, they are on the left of the origin. For the y-axis, they are in front of the origin, and the positive numbers increase away from you. This way of describing the world is referred to as "z-up".



Z-Up World Space

Another method, generally preferred by artists and animators, has the axes changed, so that y points up, and z points toward you.

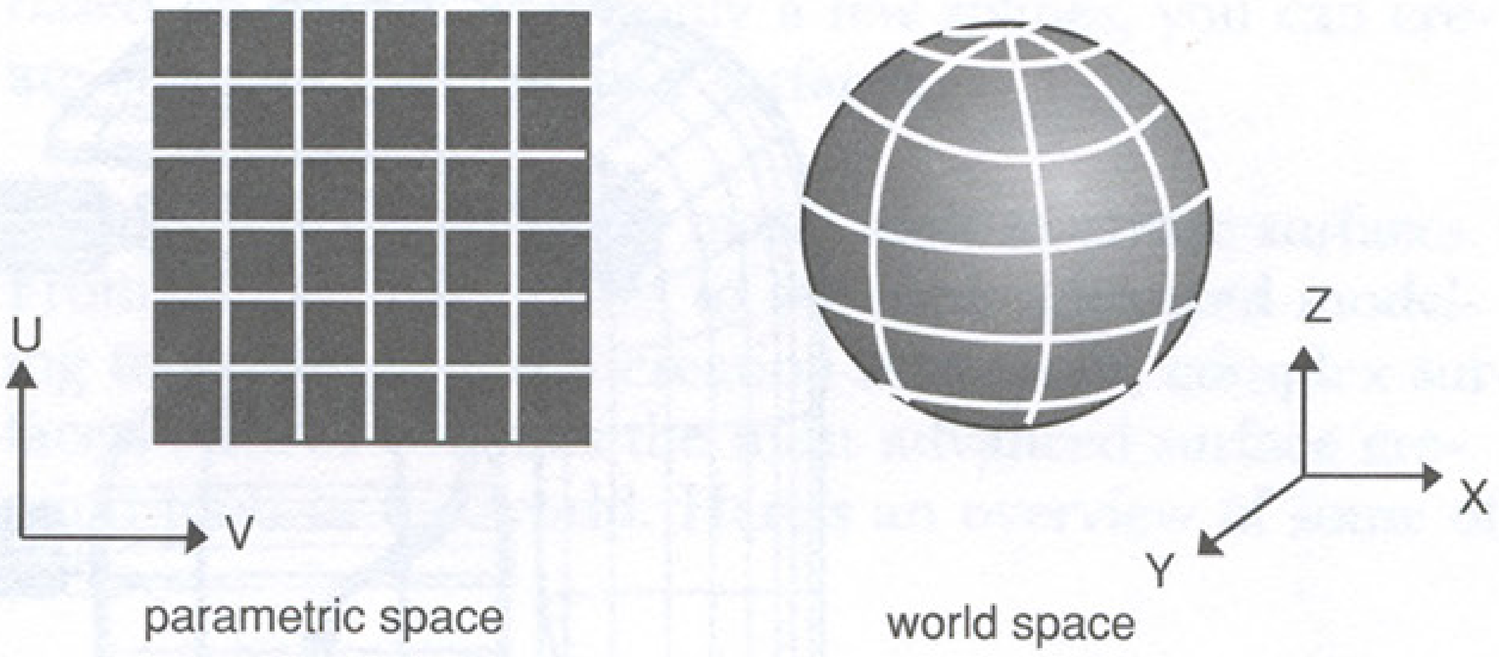


Y-Up World Space

Parametric Space

There is an additional type of space in ALIAS, called parametric space. Parametric space is the two dimensional space of surfaces. Imagine that every object is covered with a square piece of fabric that can be stretched or shrunk to fit the object perfectly without any folds or tears. This fabric could be taken off of the object and represented in two dimensions.

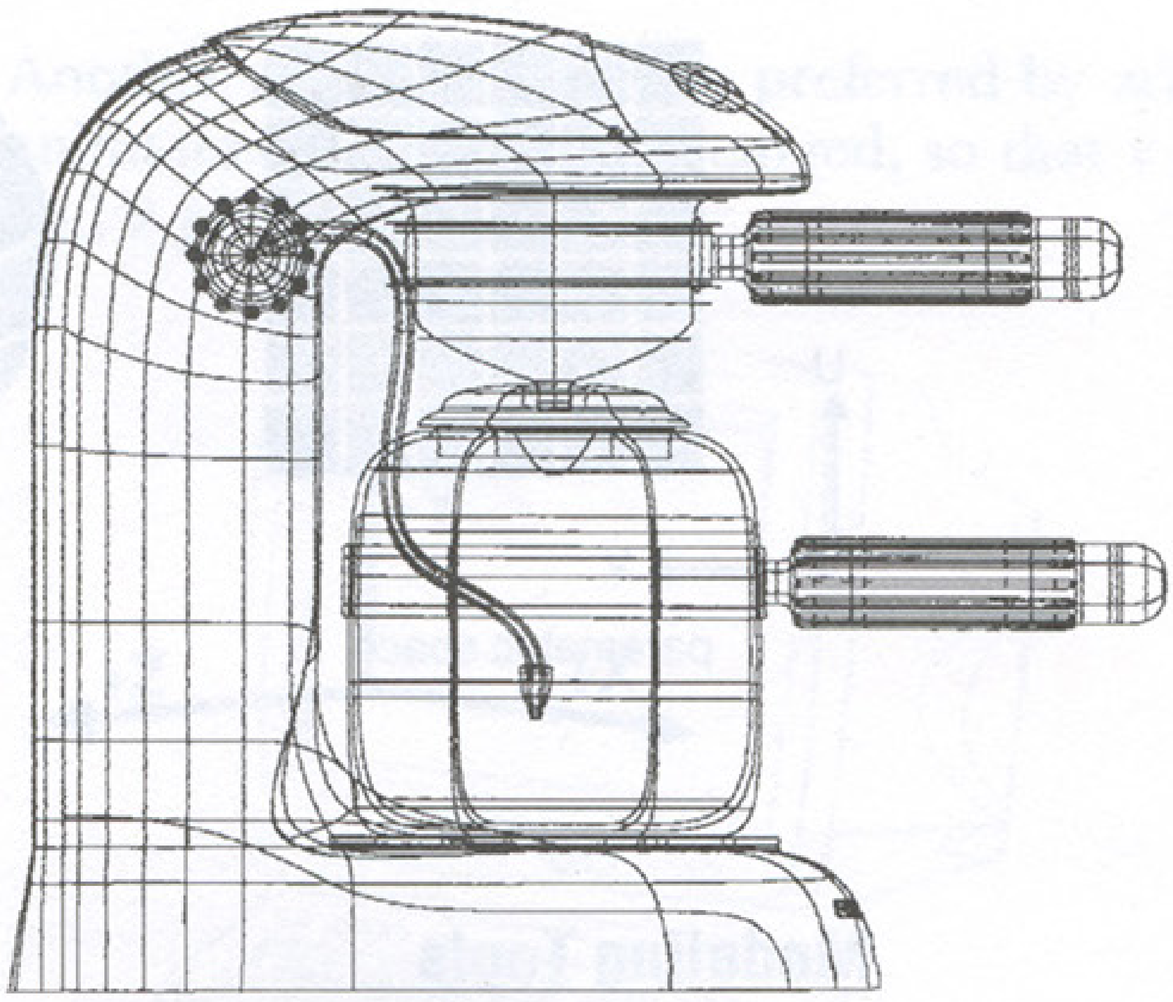
We use parametric space to describe a position on the surface of this fabric. In order to keep parametric space and world space distinct, parametric space has a different coordinate system. Instead of x and y for the two axes, they are called u and v. An alternate name for parametric space is *u-v space*. The following diagram shows how a surface can be represented in two dimensions.



Modeling Tools

Splines Spline-based modeling results in more real-world, smooth surfaces than you would be able to achieve if you had to create the model with straight lines or polygons. This gives you better control over the shape of the model you're creating. And only ALIAS offers such easy-to-use interactive spline-based modeling. Creating splines with ALIAS is fast and easy. All you do is click on the mouse where you want your CVs to be placed, and ALIAS automatically creates the splines.

Wireframe Modeling The next step in creating a model is to take a two or three dimensional spline and create a surface from it. A surface is a mesh of splines, like a wire mesh, that can be molded and manipulated into the final shape. A common name for this type of modeling is *wireframe* modeling, because the model looks like it has been formed out of a number of thin wires that have been placed into a grid and molded. Here's an example of a wireframe model of an espresso maker.



With ALIAS, you don't have to individually place every point in order to get a model. Several different tools are provided to simplify this process.

QuickWire Work faster with large models by placing them in QuickWire mode. Speed savings are enormous with this display wire mode.

Primitives Instead of having to create a sphere or a cube from scratch, the object can be created with a couple of clicks of the mouse because ALIAS already knows how to make these simple objects. The ALIAS modeler provides you with a number of objects, called *primitives*, to begin modeling with. They can be distorted, cut and moved to suit your purpose. ALIAS provides you with cubes, planes, circles, cones, cylinders, and spheres.

Primitives form the basis for a lot of different objects; by combining them, stretching them, or cutting them, you can create a lot of the things seen in every day life.

In addition to primitives, you have hundreds of tools for creating more complex surfaces. Again, they're all

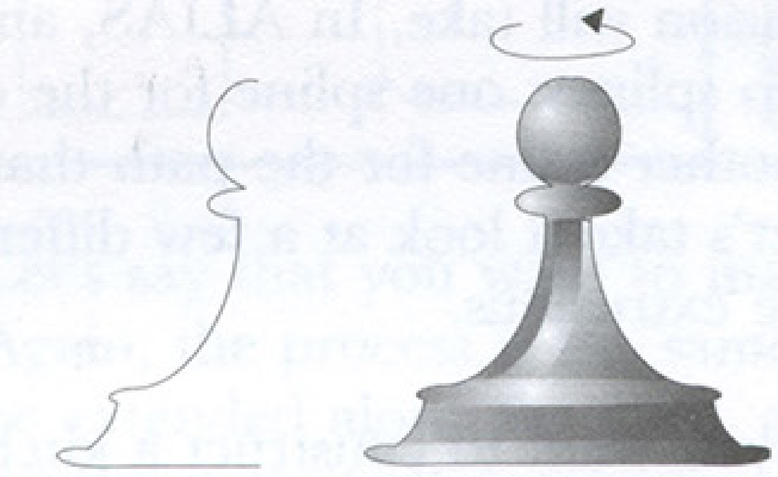
based on splines. With only a few splines, you can create complex and detailed surfaces.

Creating Surfaces with ALIAS

ALIAS systems give you many tools to create surfaces. From simple flat squares to the most advanced modeling tools for masterful creation of smooth, complex surfaces, ALIAS contains the most advanced surface creation tools in the world. Here's an overview of some of them.

Surface of Revolution

What sort of things would you want to use a surface of revolution for? Well, taking a look at objects in real life, you could use it for parts of a piston, turned wood (as in table legs), car tires, lamps, or dishware: almost any rounded object can be created with a surface of revolution.



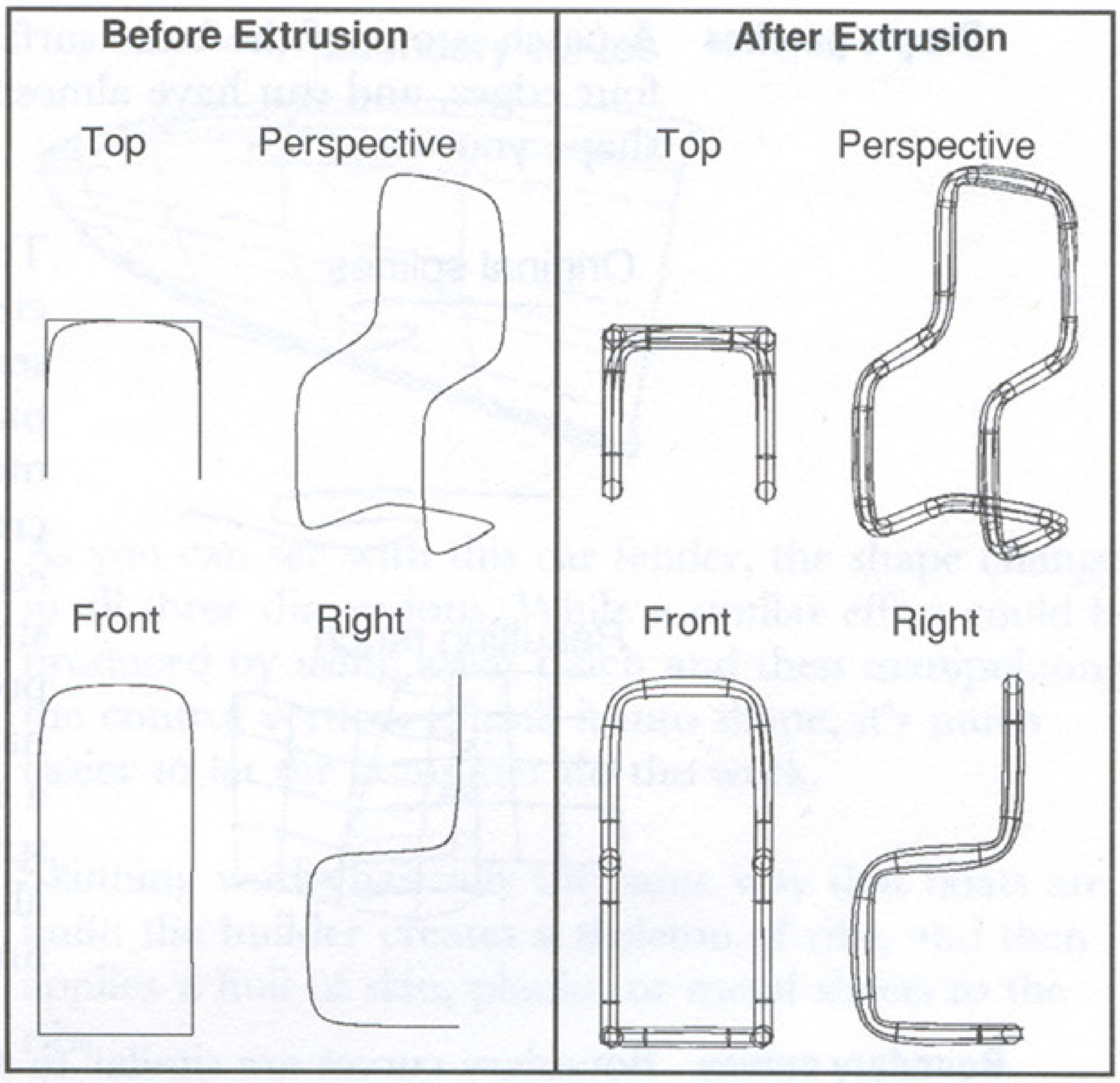
With a lathe, you define the object's silhouette, which is used as a template by the lathe to spin the raw material, creating an object with that silhouette all the way around.

Creating a surface of revolution is similar to using a lathe. You create the silhouette or profile, determine how fine you want the vertical sections to be, and revolve it. Unlike a lathe, however, you have the option of determining whether or not the object completes the revolution. A lathe depends on a closed, 360° revolution; with ALIAS, you can specify the number of degrees. If you want your object to be flat on one side, revolve it 180°. If it needs to fit in a corner, you can revolve it 90°. You can set the revolution to any number between 0.01 and 720.00° (two complete revolutions). Below is an example of a curve rotated to form a vase, with six vertical sections chosen.

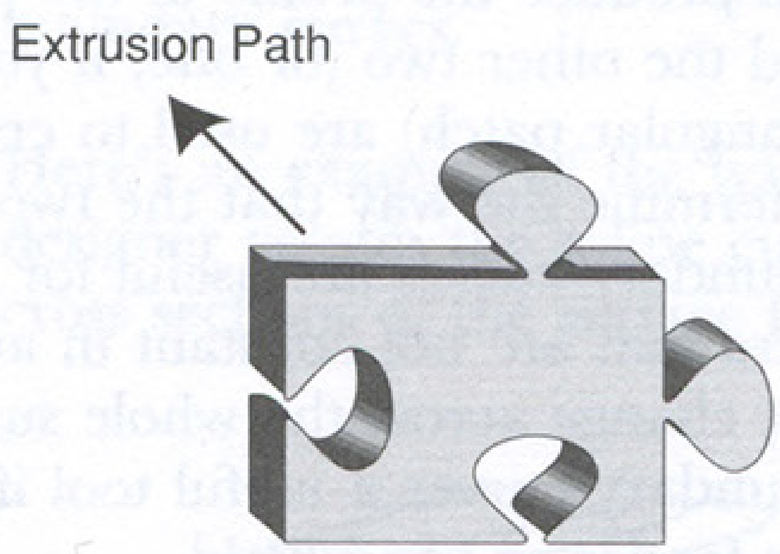
Using Two Splines — Extrusions

Extrusions are like macaroni or tubing coming out of a machine: they have a predetermined outline that remains consistent throughout their length. But unlike macaroni, which just sort of spools out of the pasta maker, with ALIAS you determine the path that an extrusion will take. In ALIAS, an extrusion is defined by two splines: one spline for the outline of the shape, and another spline for the path that the outline will take. Let's take a look at a few different ways that you can use extrusions.

If you want to construct a kitchen chair with a tubular frame, you need to design the frame. The profile of the tube is a simple circle. Now, you want it to follow the outline of the chair itself. You create the path that you want the tube to follow in three dimensions, and extrude the circle along the path. All of this happens interactively, so you see the shape you're creating as you're doing it. This gives you the ability to take the points you have placed, move them, and make alterations to the design as you continue to refine it.



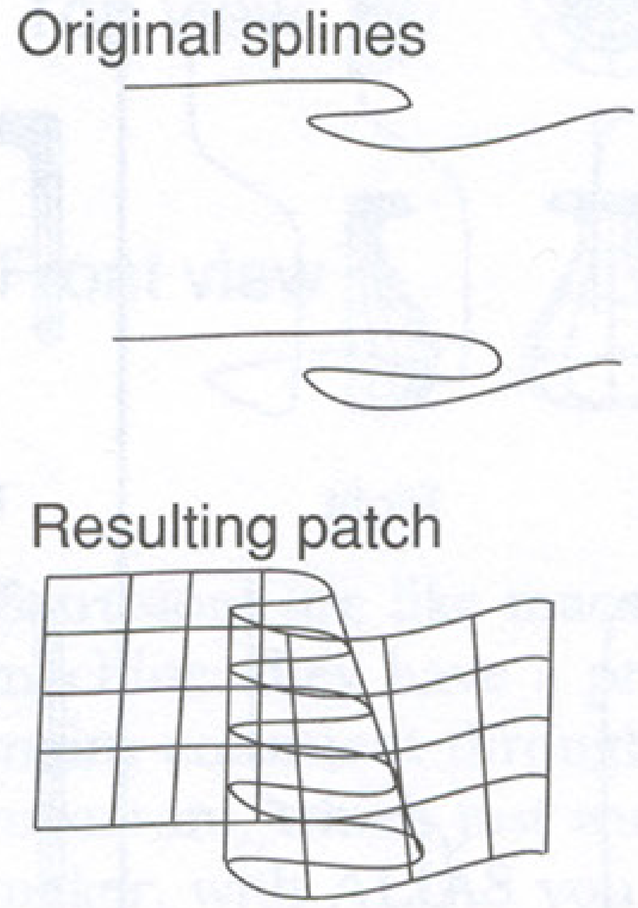
Let's say that you want to make a better bed-spring. Again, the process is the same: you create the profile to be extended along the path, and a second spiral spline for the path itself.



A puzzle piece is a short extrusion with a complicated shape and a straightforward extrusion path.

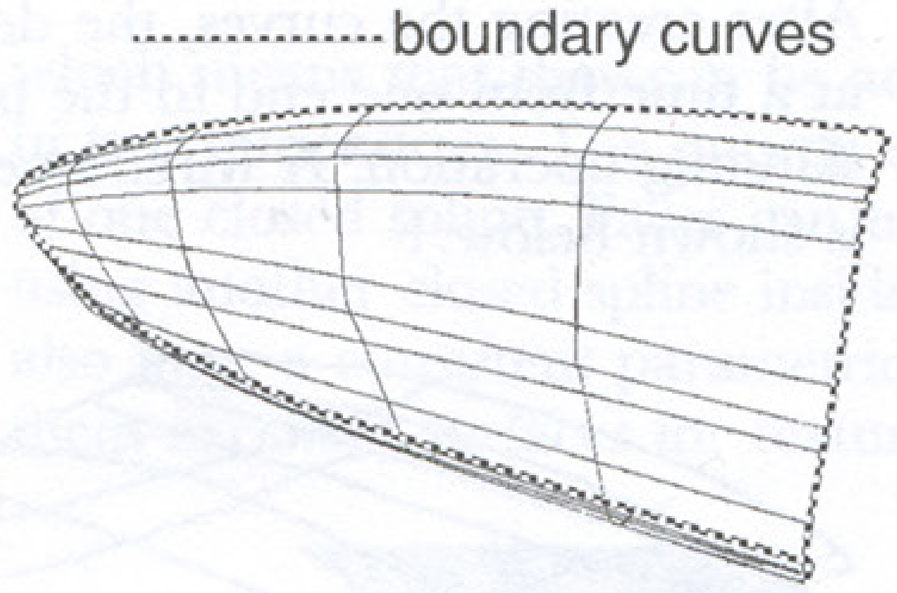
In addition to extrusions, ALIAS has other operations for creating three dimensional surfaces, including patching, using boundary curves, skinning, and creating faces.

Simple patches A patch is one of the basic surfaces in ALIAS. It has four edges, and can have almost any three-dimensional shape you want.



To create a patch, you create two splines that serve as two edges of the patch. The ALIAS modeler automatically creates the other two edges by connecting the start points and end points of the curves you have drawn. The result is a four-sided mesh of splines that is always alive for further refinement.

Boundary curves Boundary curves are similar to simple patches, except you provide splines for all the sides, or boundaries, of the surface to be created. Boundary curves give you great control over shape while creating smoothly curved, non-planar 3D surfaces. They can be either triangular or bounded by four sides. Two of the curves will produce the profile of the patch that is created, and the other two (or one, if you are creating a triangular patch) are used to create the cross section, to determine the way that the two splines will connect. Boundary curves are useful for creating complex surfaces that are not constant in any of three dimensions, but change across the whole surface. You would find boundary curves a useful tool if you were creating a car fender or windshield.



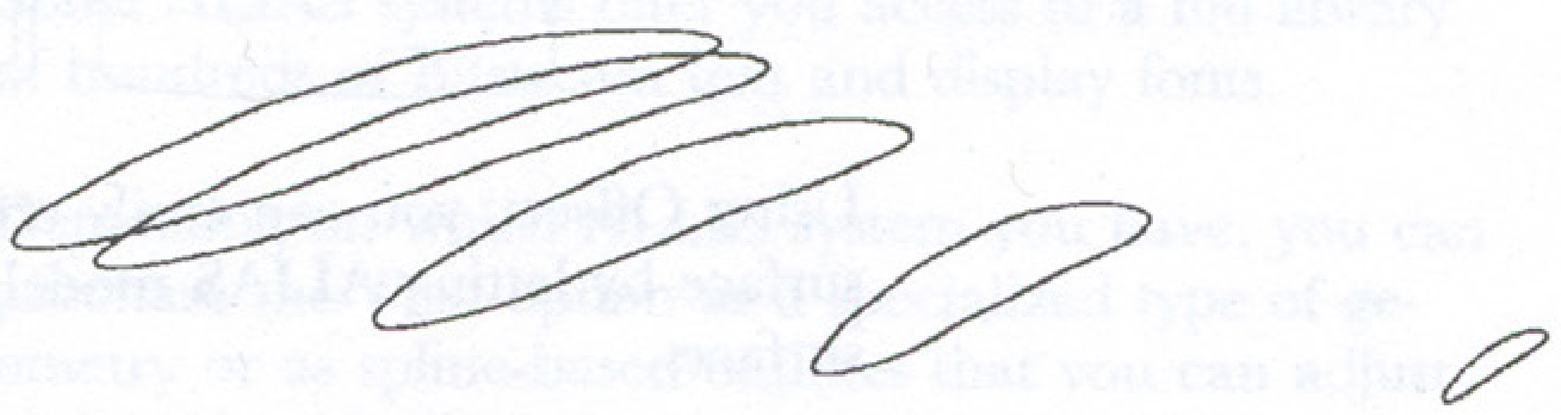
As you can see with this car fender, the shape changes in all three dimensions. While a similar effect could be produced by using a flat patch and then manipulating the control vertices to pull it into shape, it's much easier to let the computer do the work.

Skinning an object

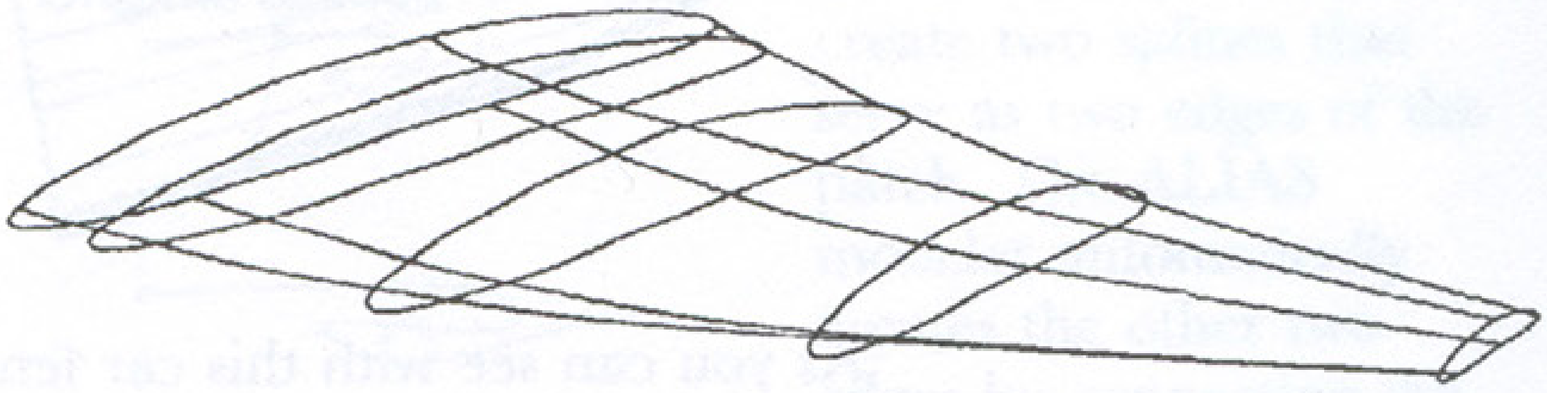
Skinning works basically the same way that boats are built: the builder creates a skeleton of ribs, and then applies a hull of skin, planks, or metal sheets to the ribs.

With ALIAS, the designer constructs a series of splines that form a skeleton of the object, and then *skins* these splines together. The skinning operation is useful for creating airplane fuselages or wings, or for creating intermediate areas between any two surfaces created with boundary curves.

Here's an example of the way skinning works. First the designer creates the spline curves that describe the cross sections of the surface for a tail fin of an airplane:

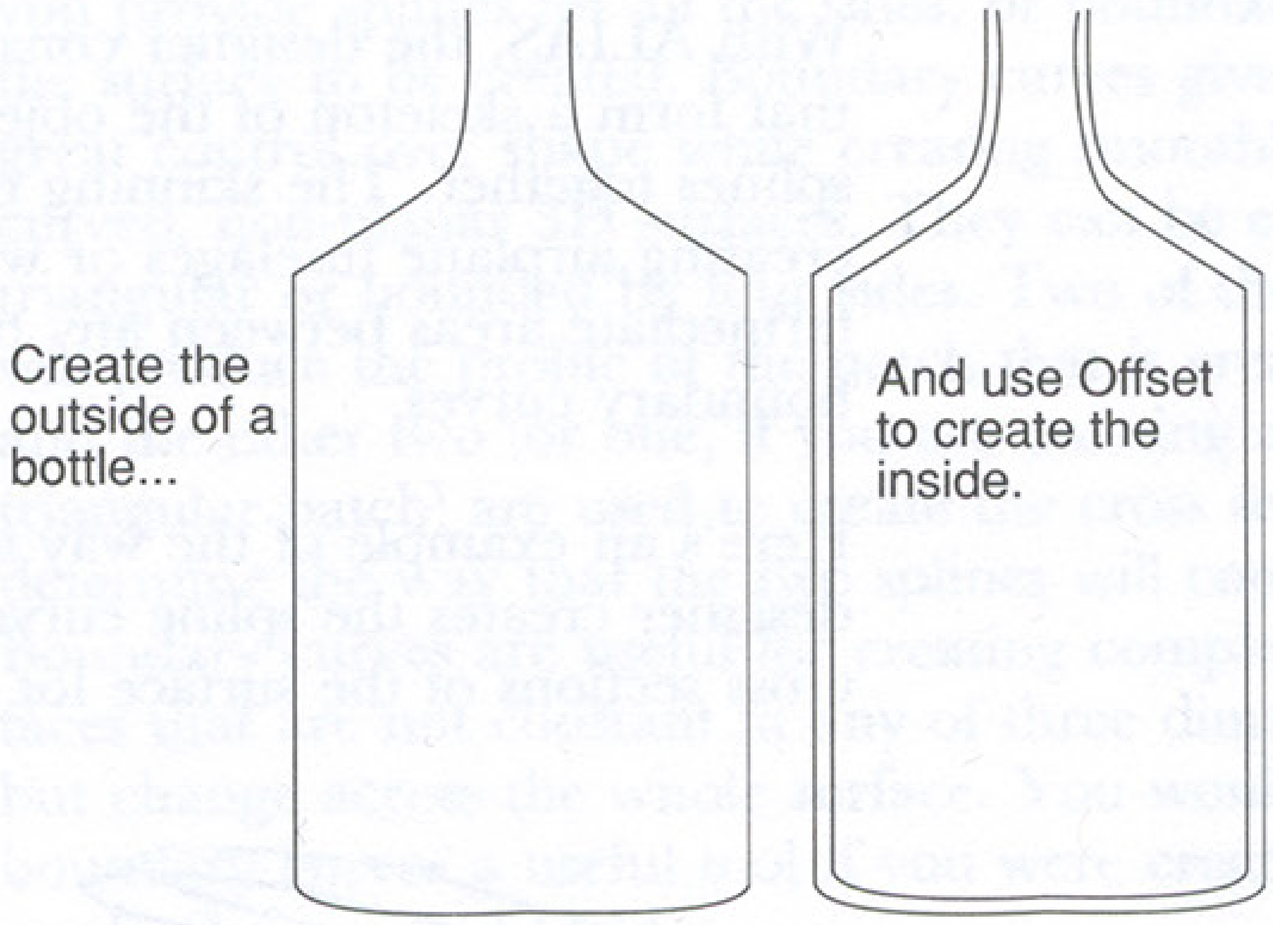


After creating the curves, the designer selects them one at a time from one end to the other to complete the skinning operation. A wireframe of the skinned tail fin is shown below.



Offset Curves and Surfaces

Offset curves and surfaces let you create precise models easily. Many objects have two distinct surfaces: for example, bottles have an inside and an outside surface. A common method is to create the inside surface by copying the outside, make it slightly smaller, adjust the inside copy so the neck fits properly, and position it precisely inside the bottle. Now you can do it in one step:

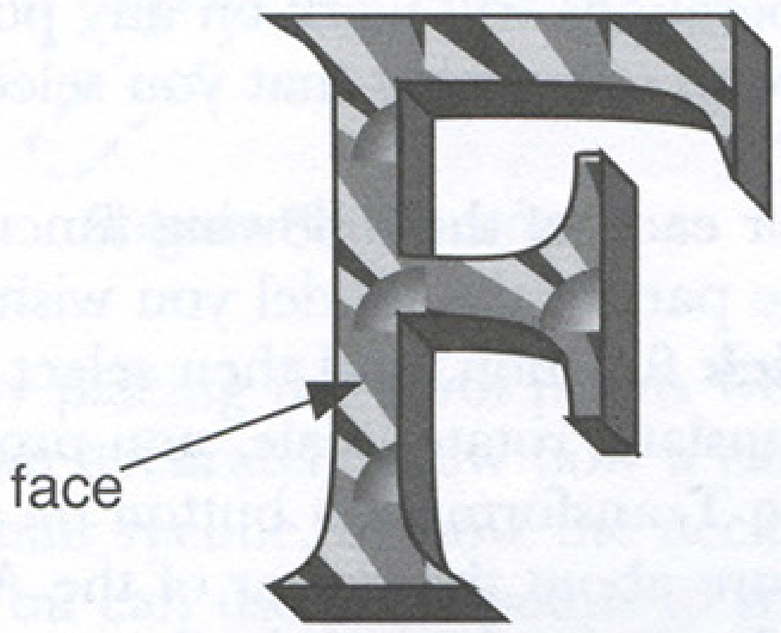


Using Offsets, you can easily create an accurate inside surface by letting ALIAS model it, based on the outside surface.

Faces

Faces are a powerful tool to use for creating logos and text characters in ALIAS. They are planar surfaces,

which means that they can be accurately represented in two dimensions. The outside edge of a face is made of one closed spline. Faces can have holes in them, by using another closed spline inside the outer one. They also have a consistent parametric space, which makes them excellent surfaces for texture mapping.



The front of the letter "F" is a face. It's made with one spline.

Text ALIAS offers a number of fonts that are useful for quickly creating logos or labels, annotating objects, or creating titles.

To assist you in using ALIAS text, there are a number of settings available, including *Justification* to set a line of text flush left, center, or flush right, and *Letter size* to control the height of the text. *Word spacing* controls the width of the space character used between words and *letter spacing* controls the spacing of adjacent letters.

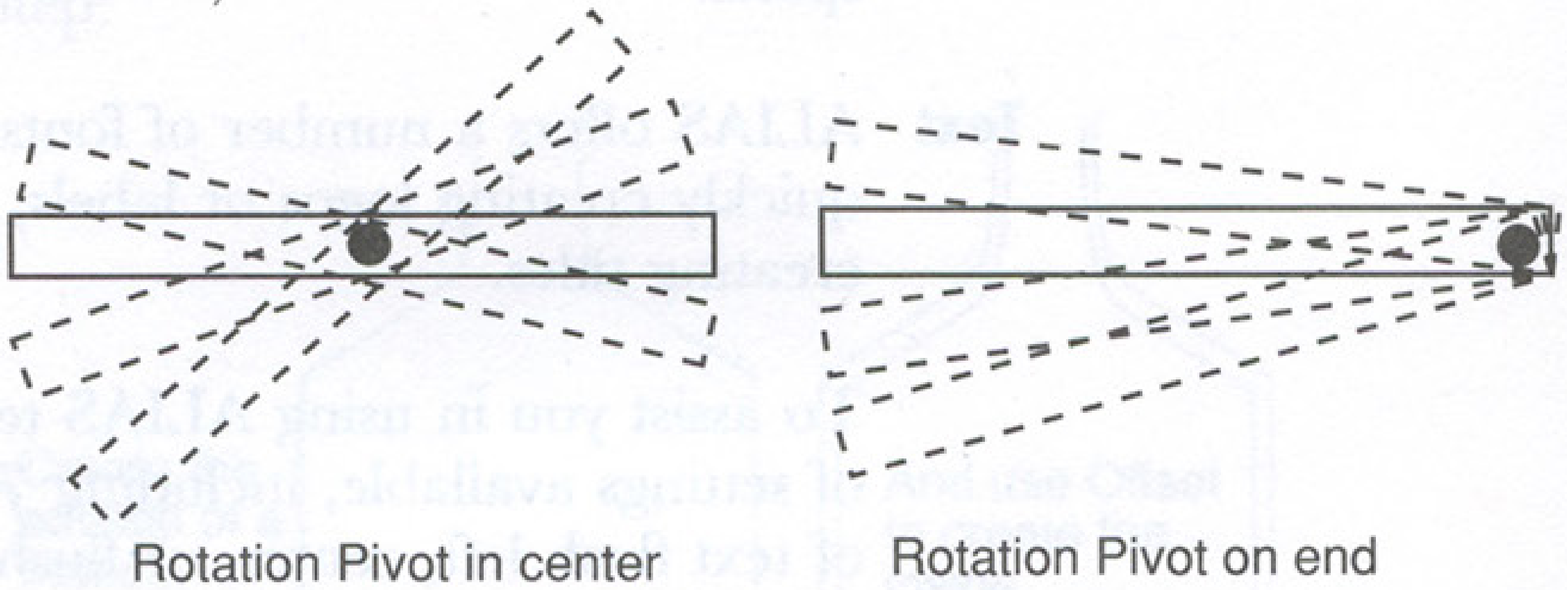
Some ALIAS systems offer you access to a full library of hundreds of Bitstream text and display fonts.

Depending on which ALIAS system you have, you can purchase the Text option as a specialized type of geometry or as spline-based outlines that you can adjust and work with like any other modeling splines.

Assembling and positioning your model

Creating great surfaces is the first step in building real 3D models. These surfaces then have to be put into their proper places. The three most common operations (called *transformations*) to do this are translation, rotation, and scaling. These three transformation operations will work on any point, single surface, or group of surfaces that you select.

For each of the following functions, you simply choose the part of the model you wish to affect by using the **Pick** function, and then select the type of effect — translate, rotate, scale, non-proportional scale — from the Transformation button on the menu. (To learn more about the power of the ALIAS **Pick** function, refer to the sections in the appendix about momentary and continuous buttons.)



Rotation Pivot in center

Rotation Pivot on end

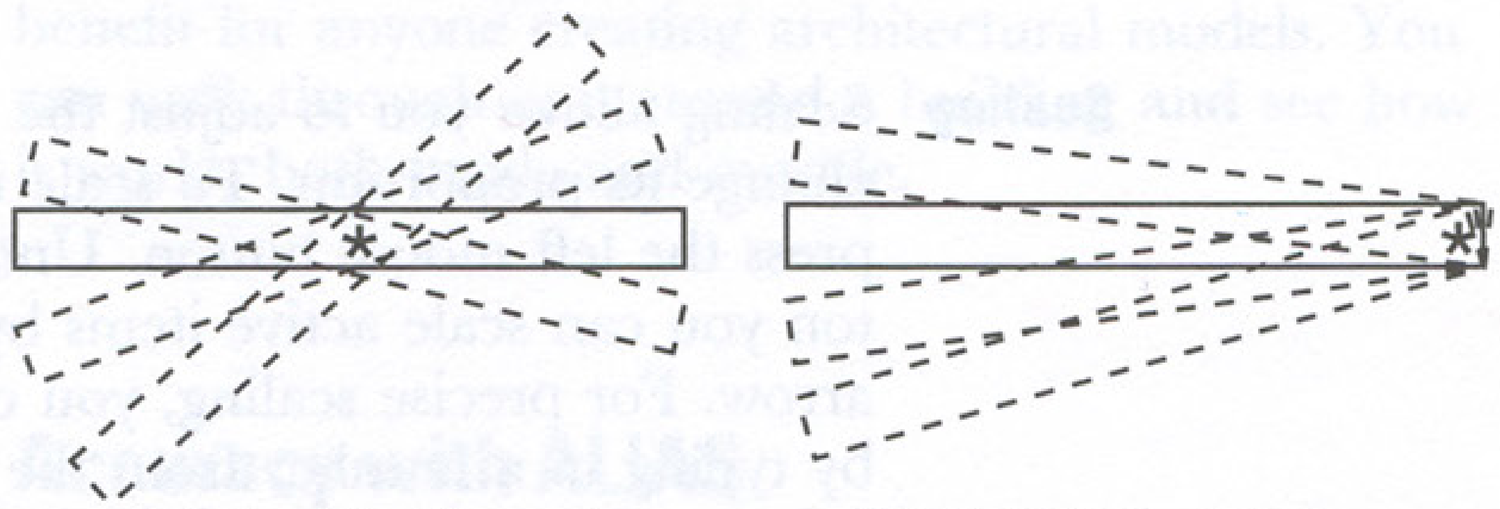
Once an object is active, you can select the type of transformation you want to perform.

Pivoting - Object relationships

Every object that you create in ALIAS has two pivot points: one to scale the object, and one to rotate it. By default, these pivot points are placed at the center of the object in the case of primitives, or at the origin (0, 0, 0) for surfaces, splines, or groups of objects.

With ALIAS, you have the ability to move the pivot points anywhere: you can place them at the center of the object, at one end of it, or outside the object.

Here's how the placement of the roation pivot point changes how an object moves:



Rotation Pivot in center

Rotation Pivot on end

By placing the pivot points where you want them, you can accurately show how a car door will open, or a chair recline, or how the neck on a desk lamp moves. You can use pivot points to show how an object squashes or stretches under pressure.

Translating

Translating an object means moving it. You can move groups of objects, single objects, single surfaces, parts of an object, or parts of a surface. To accomplish this, place the cursor near your object and press the left mouse button. Until you release the button, you can move the items in any direction by dragging the cursor arrow to a new position. For convenience, pressing the middle mouse button allows the items to move horizontally, and the right button moves objects vertically. For precise movement, you can also enter values from the keyboard. ALIAS gives you a choice of whether you are entering relative or absolute values. This is a powerful choice that lets you choose to move objects in relation to each other, or set them in a precise spot in world space.

Rotating

Rotating lets you change the orientation of an object. To rotate items with the mouse, press the left mouse button. Until the button is released, the items can be rotated by moving the mouse. The middle mouse button rotates the items around one axis, while the right button restricts rotation to the other axis. For precise

rotation, you also have the choice of using the keyboard to rotate items, by entering values for rotation about the x, y, and z axes.

Scaling

Scaling allows you to adjust the size of your object and change its proportion. To scale items with the mouse, press the left mouse button. Until you release the button you can scale active items by dragging the cursor arrow. For precise scaling, you can also scale an object by typing in a number from the keyboard.

Scaling objects gives you the freedom to build your surfaces at whatever size you want, and then make all the pieces fit together by scaling them appropriately.

Non-Proportional Scaling

A special type of scaling operation is non-proportional scaling. It lets you modify your model by increasing or decreasing the scale in one or two dimensions, without doing it in all three. This has the effect of stretching or squashing an object.

To non-proportionally scale items with the mouse, press the left mouse button. Until you release the button, you can scale the active items by dragging the cursor arrow. Horizontal movement causes scaling in one dimension, while vertical movement causes scaling in the other. Press the middle mouse button to scale only in one dimension, or the right mouse button for the other dimension. Again, you can enter numbers from the keyboard to gain greater precision.

Undoing your work

ALIAS gives you the freedom to make mistakes without having to start from scratch if you don't like what you've done. The **Undo** capability works with all the above transformation functions: this means that you have the power to change your mind: move your object, change its scale, or rotate it — and return to your original if you don't like the result. All you have to do is select the ***undo*** pop-up on the Transformation button.

Helicopter Seeing a model from all sides is made easier with the ALIAS Helicopter function: it's like being in a helicopter and flying around your model. It's a great benefit for anyone creating architectural models. You can walk through and around a building and see how it works, both inside and outside.

Accuracy with ALIAS

ALIAS gives you a number of tools you can use to accurately create a model. With ALIAS, you can:

- Measure objects, surfaces, clearance between objects, and angular measurements (in degrees or radians) easily with functions available in ALIAS Evaluation Tools. Create models to scale with great accuracy.
- Check details about your model. The object's position, scale, and the surface properties assigned to it can be examined and changed in movable displays called Stats Windows. With Stats Windows, you can name your objects to keep a detailed record, and to make it easy to select specific elements when you have many objects on the screen. To call up Stats Windows, all you have to do is select a button.
- Have complete control over the accuracy of your model by determining the scale of the grid system you choose to use. User-selectable grids give you the ability to snap to the grid when creating splines or moving objects.

Advanced Modeling

Certain ALIAS systems contain Advanced Construction Tools. These form the designers "tool box" for creating high quality curves and surfaces with unparalleled flexibility and manufacturable accuracy. The following tools give you advanced modeling capability:

- Trimmed Surfaces: to cut holes in surfaces and seamlessly join objects together.
- Fillets: join two surfaces or curves together with a smooth, rounded edge.
- Swept Surfaces: create surfaces based on sweeping one profile curve along a path curve.
- Birail Surfaces: creates surfaces by sweeping one or more profile curves along two path curves (or "rails).
- Square Surfaces: create smooth surfaces with four edges.
- Align: match up the edges of surfaces or curves smoothly.
- Combine Curves: create smooth 3D curves from a pair of 2D curves.
- Rebuild Curves: reduce the amount of data on digitized or imported curves.
- Adjust Intersection: make two curves meet exactly where and how they should.
- Tolerance Table: set the degree of accuracy **you** want for building your models.

Trimmed Surfaces

Once you've created a surface, you may want to automatically cut holes in it or fit two surfaces together. ALIAS's Trimmed Surfaces is the power to interactively cut sections from surfaces and seamlessly fit objects together by trimming away excess material. Without this ability to trim a surface, designers have to consider all of the final detailed elements of an object, including holes and indentations, at the very start of the design.

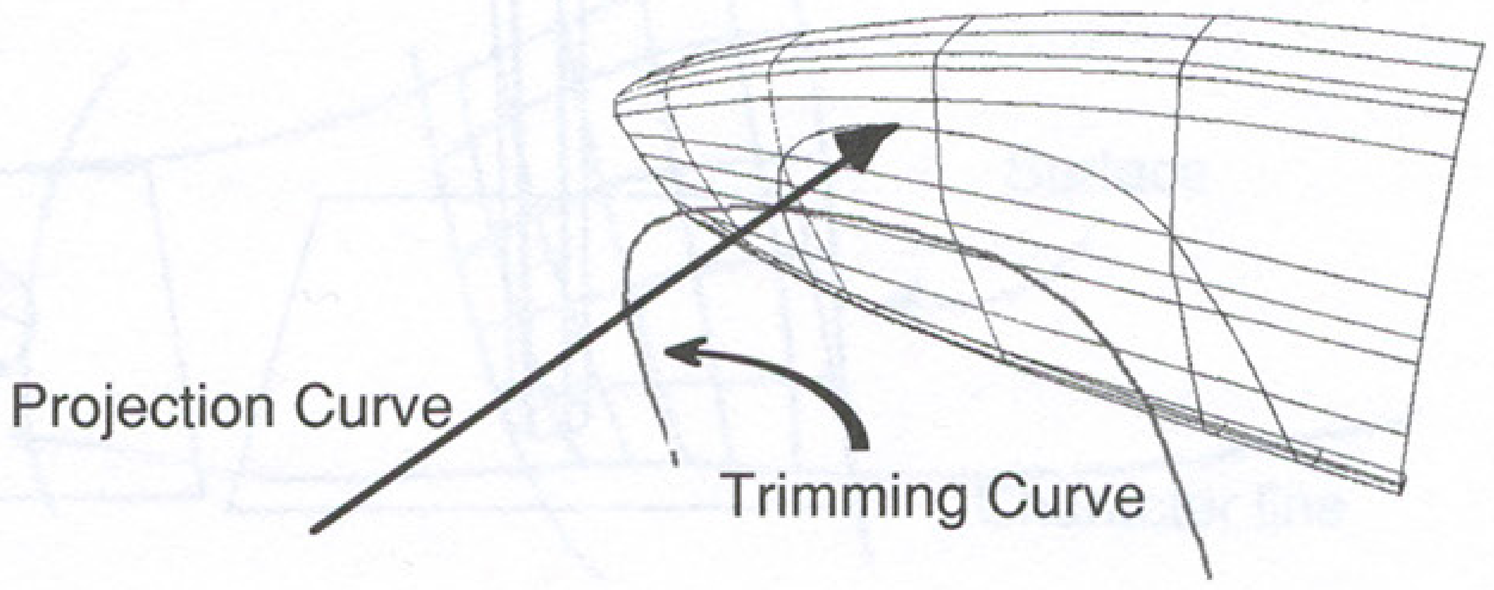
ALIAS Trimmed Surfaces is a simple tool for cutting away at objects in three dimensions. ALIAS lets you

work the way that you see things, not the way a computer does. You apply one or more trimming curves to an existing surface to create a new surface with trimmed away areas.

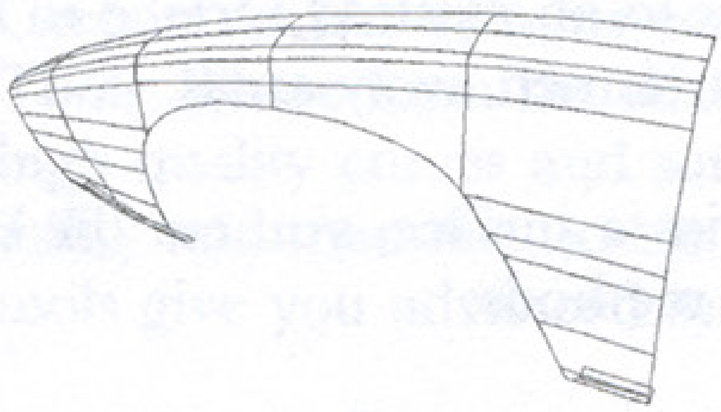
To trim a surface, you cut the surface with one of three methods:

- project a curve onto a 3D surface, using what is called a *projection vector*. In this method, you use two curves: the trim curve, which you create away from the surface and which shows the shape that you want to trim, and the projection vector, which shows the direction that you will use to project this curve onto the surface.
- intersect two or more surfaces, and trim where the two surfaces pass through each other, to end up with a perfect fit between two surfaces.
- place Trim Vertices (just like CVs) directly on the surface you want to trim.
- project a curve onto a surface using Geometry Mapping to get the exact shape of the curve trimmed by using parametric mapping.

Here's a simple example of a car fender about to be trimmed, with the trim curve and projection vector in place:

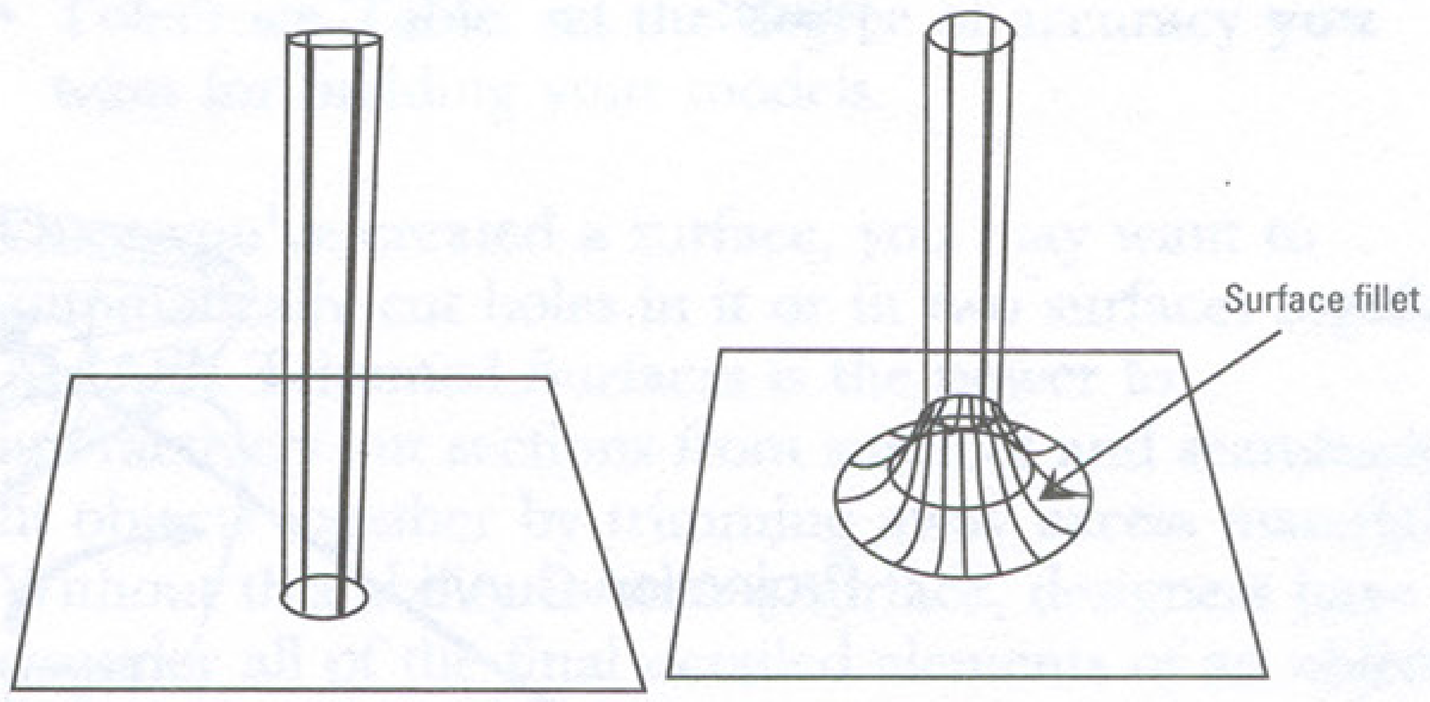


Here's a view of the completely trimmed fender.



Fillet Filleting is a fast and easy way to create a smooth rounded curve between two existing curves, or a rounded edge between two surfaces. The curve filleting function creates a rounded curve between two curves. Curves don't have to intersect. You'll find curve fillets useful for creating curves with the exact amount of roundness you want.

Surface fillets are great for creating any object with rounded edges, or in situations where you want to blend two surfaces together. Here's an example of what a surface fillet does. If you want a cylinder to protrude through a flat surface, but have a smooth, rounded edge where the two join, you create the cylinder and the surface. By using the fillet function, you get a smooth taper happening all the way around.



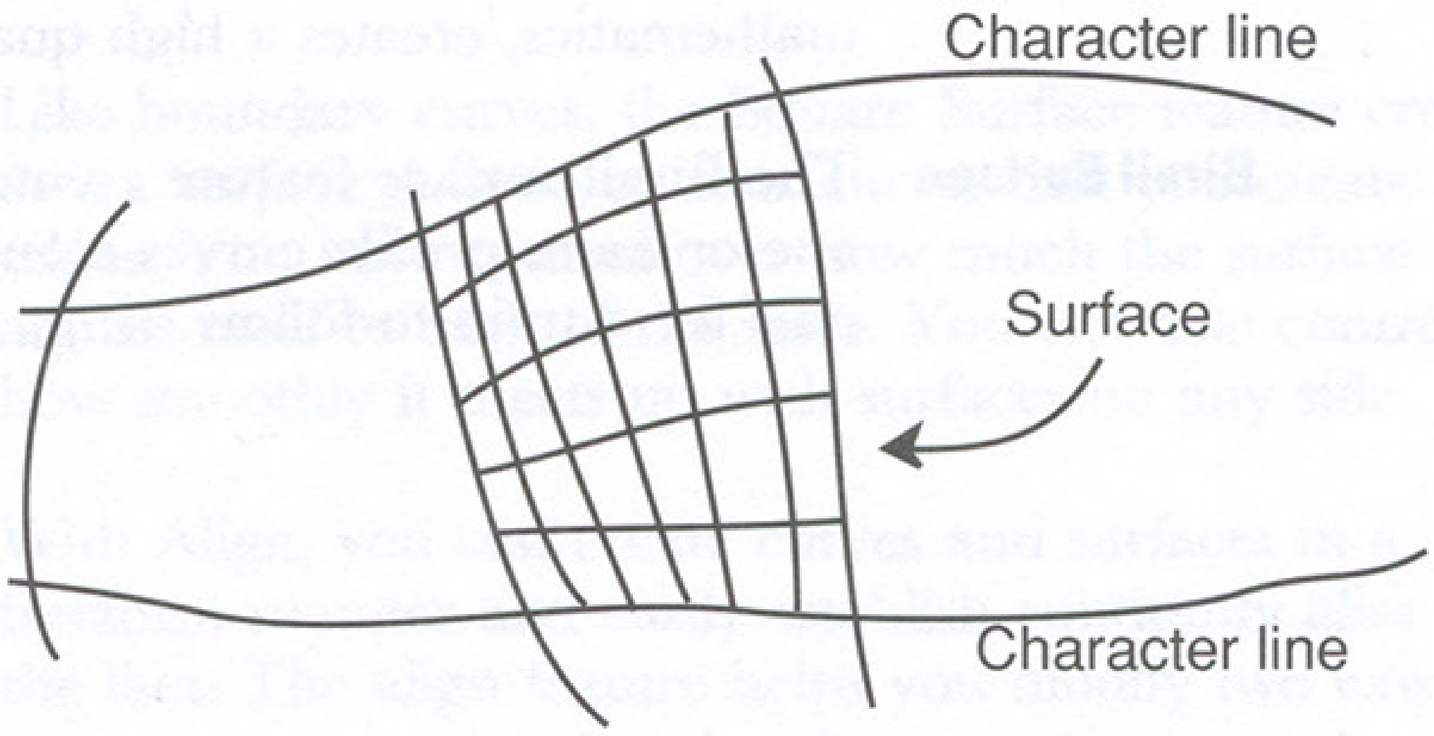
Smooth Surfaces

The following three surface creation functions have some features in common. They all help you create smooth surfaces by:

- automatically rebuilding curves to reduce data
- using part or all of a curve, such as a character line, to create surfaces. Surfaces don't have to go the full length of the curves.
- enforcing surface continuity with adjacent surfaces, if you want it.

With ALIAS Advanced Construction Tools, you can automatically create the design curves required for complex 3D modeling from the 2D "character lines" produced using traditional design methods. Character lines are curves that give the overall feel of an object: they tell you what the object's character is like: sporty, classic, fun, etc.

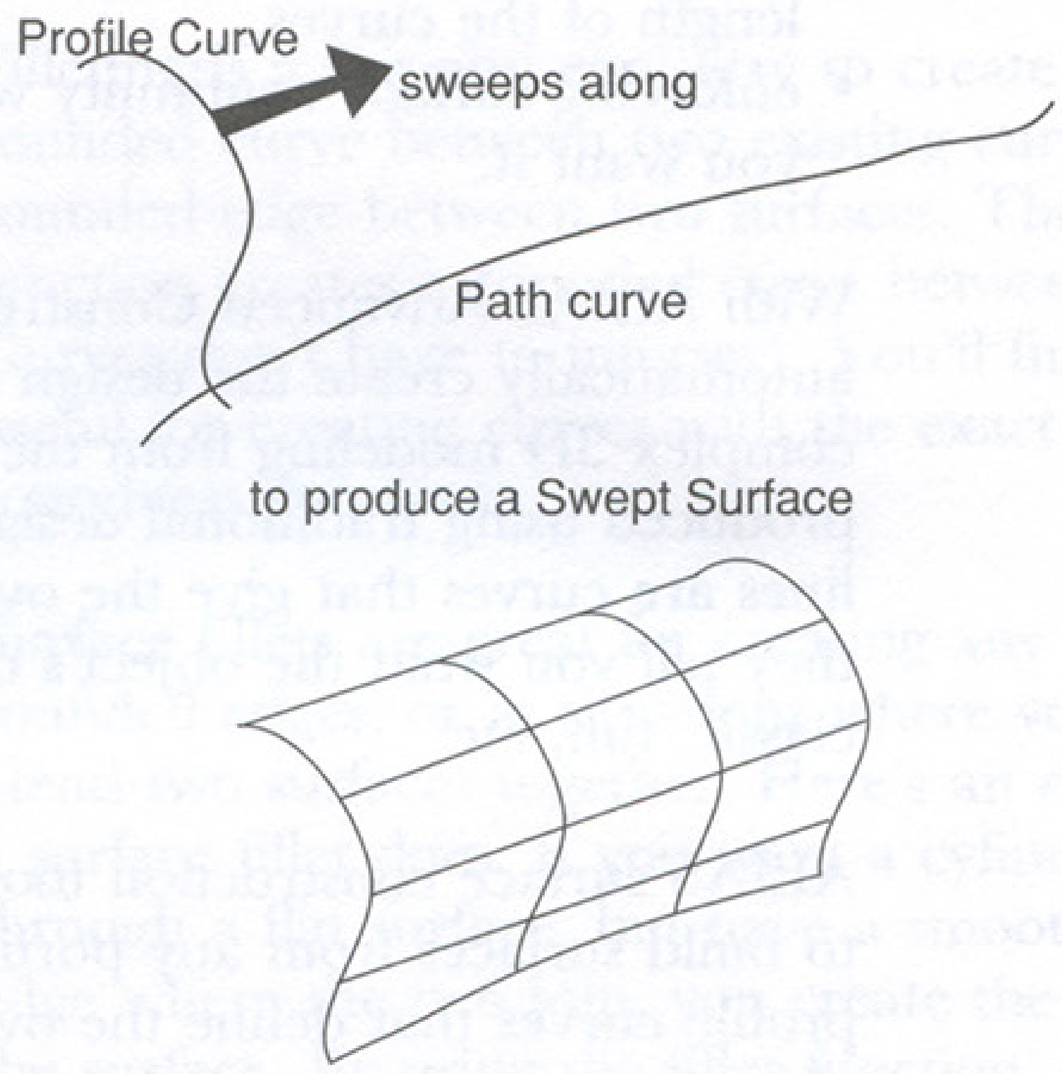
ALIAS surface construction tools give you the flexibility to build surfaces from any portion of the full length profile curves that define the over-all shape of an object, without having to break up the curves to define the separate surfaces the way CAD systems do.



As you build the surfaces along the character lines, the system automatically matches the edges of the surface with pre-existing surfaces, creating a high quality,

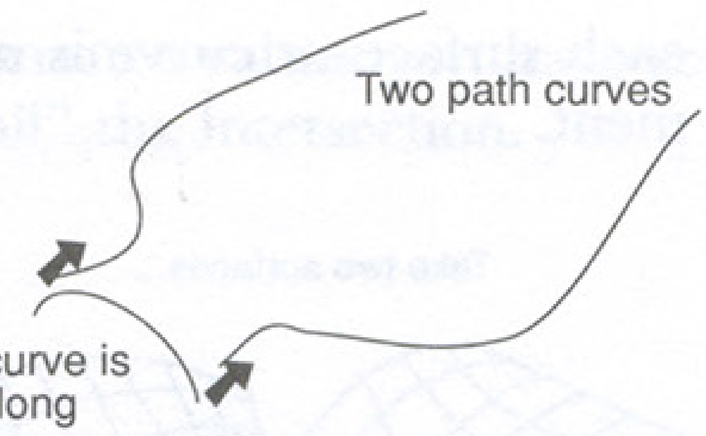
manufacturable model without increasing the demands on you, the designer.

Swept Surfaces The Swept Surface feature creates a surface by sweeping a profile curve along a path. Use it to create surfaces from profile curves and character lines, which define the global shape of an object.

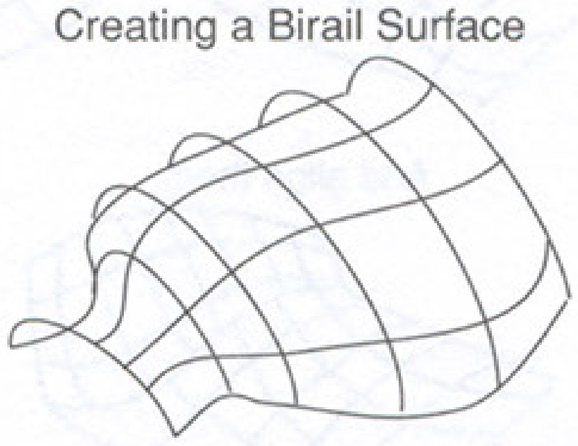


This function gives you control over the character of the surface and, because of the underlying mathematics, creates a high quality surface.

Birail Surface The Birail surface feature creates a surface by sweeping one or more profile curves along two path curves like rails for a train to follow.



Creating a Birail Surface



The power of Birail is the ability to make the new surface smooth with adjacent surfaces where they join. You can use this feature to create surfaces from profile curves and "character" lines, which define the global shape of an object. Because of the underlying mathematics, you can create a high quality surface for manufacture.

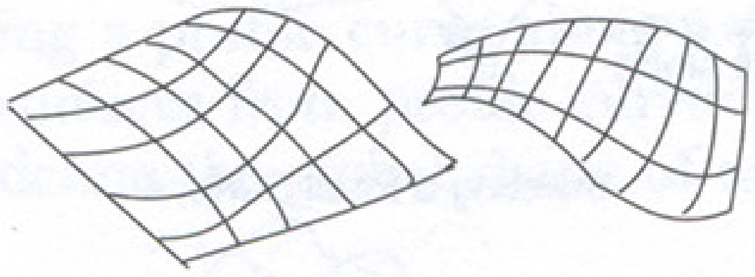
The Birail function works by sweeping the profile curve along the path curves. If the path curves move farther apart or closer together, the profile curve scales up or down to fit the rails.

Square Surfaces Like boundary curves, the Square Surface feature creates a surface defined by four curves that you create as edges. You have control over how much the surface adjusts itself to each of the sides. You can also control how smoothly it meets up with surfaces on any side.

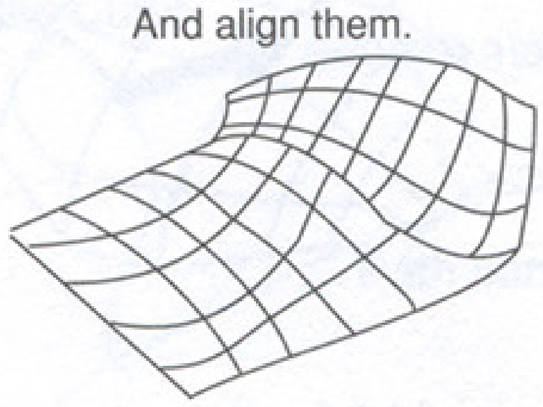
Align With Align, you can create curves and surfaces in a freeform manner and easily establish continuity after the fact. The align feature helps you modify two existing curves or surfaces so they butt up against each other or have the same tangent at the ends of the curves or surfaces. You have control over how much of

each surface or curve is modified to achieve the alignment.

Take two surfaces...



And align them.



Combine Curves The Combine Curves feature creates a composite curve in three dimensional space from two profile curves. Using this feature, you can create flat character lines in the front, side, and top windows, and automatically create the 3D design curves required for complex modeling. For example, if you have flat top and side views of a model, you can pick a curve that is common to both views and create it in three dimensions.

Rebuild Curve The benefit of this tool is that you can reduce the amount of data in a model if your curve is defined by numerous points, without taking away from the quality of the curve. This can happen when you are working with digitized data, or curves created from surface intersections. This feature gives you the ability to remove control vertices from a curve while still having it stay the same shape as the original curve.

Adjust Intersection Adjust Intersection gives you greater accuracy in your design than you would have if you manually adjusted curves. This feature lets you adjust curves after you create them so they meet or cross in all three dimensions. It's an accurate way of moving or reshaping curves that adjusts the curves according to

the tolerance values you have set, without having to "eyeball" the intersection.

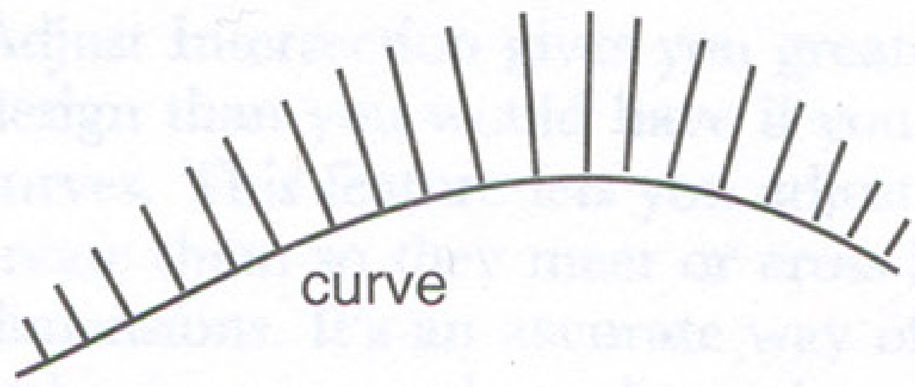
Advanced Evaluation Tools

ALIAS Advanced Evaluation Tools give you the revolutionary capability of assisting you in seeing the quality and precision of your design. You can evaluate your design, while you design, interactively, reducing the need for physical prototypes. With the Advanced Evaluation Tools, you can be sure your design will meet engineering and manufacturing requirements.

Curve curvature

Previous to ALIAS, this functionality was limited to the most advanced engineering systems. ALIAS provides the designer with the ability to evaluate the quality of elements of a design before it is built. Seeing the curvature plot of a curve gives you a deeper understanding of how your design is working: you can see and interactively change curves while a graphic display of the curvature keeps you up to date on how the curve is behaving.

You have your choice of two different displays of curvature: one is best for examining relatively flat curves, and the other is best for highly curved splines. Curvature information is plotted using straight lines drawn outward from the curve, with the line length proportional to the amount of curvature at that spot. This means that you can easily judge how a curve is working just by looking at the lines coming out from the curve and seeing how their lengths change when you change the curve. A smooth curvature plot means constant curvature: a curvature plot with a smooth rate of change means the curve changes gradually, with no sudden changes that could mar the finished surface.



Curve curvature plot

Evaluation Images

In the past, the evaluation of surface quality and alignment using computer graphics technology was limited to shading the surfaces and visually checking for obvious imperfections. Alias has developed unique surface evaluation tools called *Curvature Evaluation Image* (CEI) and *Highlight Evaluation Image* (HEI), which give designers the ability to view, precisely, the surface quality and character.

Curvature Evaluation Image

The CEI displays curvature information on the surface so you can evaluate the properties and quality of the surface. This extremely sensitive analytical tool can detect local surface changes that were previously detectable only on the final milled model. By selecting different colors to represent different ranges of curvature, you can reveal an undesired surface change in a design by seeing the change in curvature on the surface.

Highlight Evaluation Image

The HEI simulates natural highlights on surfaces, allowing you to understand the global surface character of your design. In traditional methods of design, the designer can never view the surface highlights until a physical model of the design has been built and lights focused on the model. By simulating the surface highlights in the computer, you can now actually design with light. You have full control over the direction of the highlight and using the color pattern to tailor this tool to your own style.

Min/Max Curvature

The min/max curvature feature identifies the points of minimum and maximum curvature on a surface to assist the designer in progressively refining the surface as he or she designs.

Mass Properties

Mass Properties helps you discover the real world characteristics of your computer model. This time saving option means that you can check the volume and surface area of an object early in the design process. It gives you freedom to experiment: with the calculation of the mass properties of an object made easy, you can effortlessly identify the results of any changes made to an object.

Volume

The SOLID option is used when the picked surfaces form the bounding surfaces, or skins, of closed solid masses. You can use this function to determine how much material is required to create the object you are designing. You can also use this option to calculate the volume of space in, for example, a salad dressing bottle. If you are designing a bottle to hold 750 ml of liquid, you can make sure that it will contain the correct amount of liquid.

There are also options for surfaces used to model a thin shell enclosing a hollow space, as in the case of modelling a bottle with a single surface. When you calculate the volume in this case, the amount of material required to manufacture the bottle, rather than the bottle capacity, is calculated.

Surface Area

If you're designing an object that will be painted, you can determine the amount of paint required by using the surface area calculation.

In addition to the above calculations, Mass Properties also helps you evaluate more complex attributes, such as the center of gravity and moments of inertia of the object.

Data Transfer

To create real-world products, your design must get to engineering and manufacturing. With ALIAS, this is fast and precise.

ALIAS has the ability to move and translate data from one system to another, so you can share a common database throughout the product design and manufacturing cycles. Models created using ALIAS can be transferred to CAD/CAM systems for analysis, design documentation, or manufacturing. Additionally, models created on other systems can be transferred into ALIAS for high quality rendering, enhancement of the design, or animation.

ALIAS NURBS geometry allows for the highest possible accuracy in Data Transfer.

Supporting the Standards

By using standard file formats, you can avoid developing specialized translators for different data sets. Data from the original system is first translated to the neutral format. This is called preprocessing. The data in the neutral file format is then translated to the format of the receiving system. This sequence is called postprocessing.

ALIAS currently supports the following industry standard data transfer neutral file formats: IGES, VDA/FS, DXF, and DES.

IGES IGES (Initial Graphics Exchange Specification) is a standard file format designed for the exchange of geometric information between CAD systems.

VDAFS VDA/FS (VDA Surface Interface) is a standard file format designed by European auto manufacturers for the exchange of geometric information between CAD systems.

DXF DXF (Drawing Exchange File) is a file format developed by Autodesk, Inc. for the exchange of geometric and drawing information between microCAD systems.

DES

DES (Data Exchange Standard) is a file format developed by General Motors for the exchange of geometric information between CAD systems.

How To Move Your Data in and out of ALIAS

To read in a file from one of these standard formats, place it in the ALIAS "wire" directory and retrieve it as you would any wireframe data. ALIAS determines what type of file it is, and automatically invokes the appropriate translator. You can then bring the file into the modeler and work with it.

Similarly, designs created in ALIAS may be stored in any of the above standard file formats, then transferred to any other system that supports standard file formats.

With ALIAS, data integration is accurate and reliable.

What is Animation?

You have the power to move ideas and events over time. You can create animations, special effects or show a product design in motion. Alias animation brings your ideas to life in real time. Everything that you animate is controlled in the same consistent manner, be it a single point, a whole group of objects, or complete scenes. This makes ALIAS animation powerful to use and very easy to understand.

What to animate?

In ALIAS, you can animate anything. Most commonly, designers and artists animate objects, lights, and the camera (which is your point of view). With animation, you can capture the rotation of objects and see your models in all dimensions. You can animate lights across the surface of your object to check the the texture, colors, and continuity of surfaces. You can change an object's size or position. You can animate a camera to walk you through an architectural design — and gain a sense of human scale. Or you can do all of the above, simultaneously.

Automatic Turntable Animation

The turntable animation feature found in some ALIAS systems provides designers with a tool to automatically view and present their models as if the models were on a turntable. Creating an animation is as simple as clicking a button.

Dope Sheet Animation

The tools of animation

Animators have traditionally had a set of tools at their disposal that included such things as cameras and dope sheets. ALIAS has taken the traditional tools and improved them.

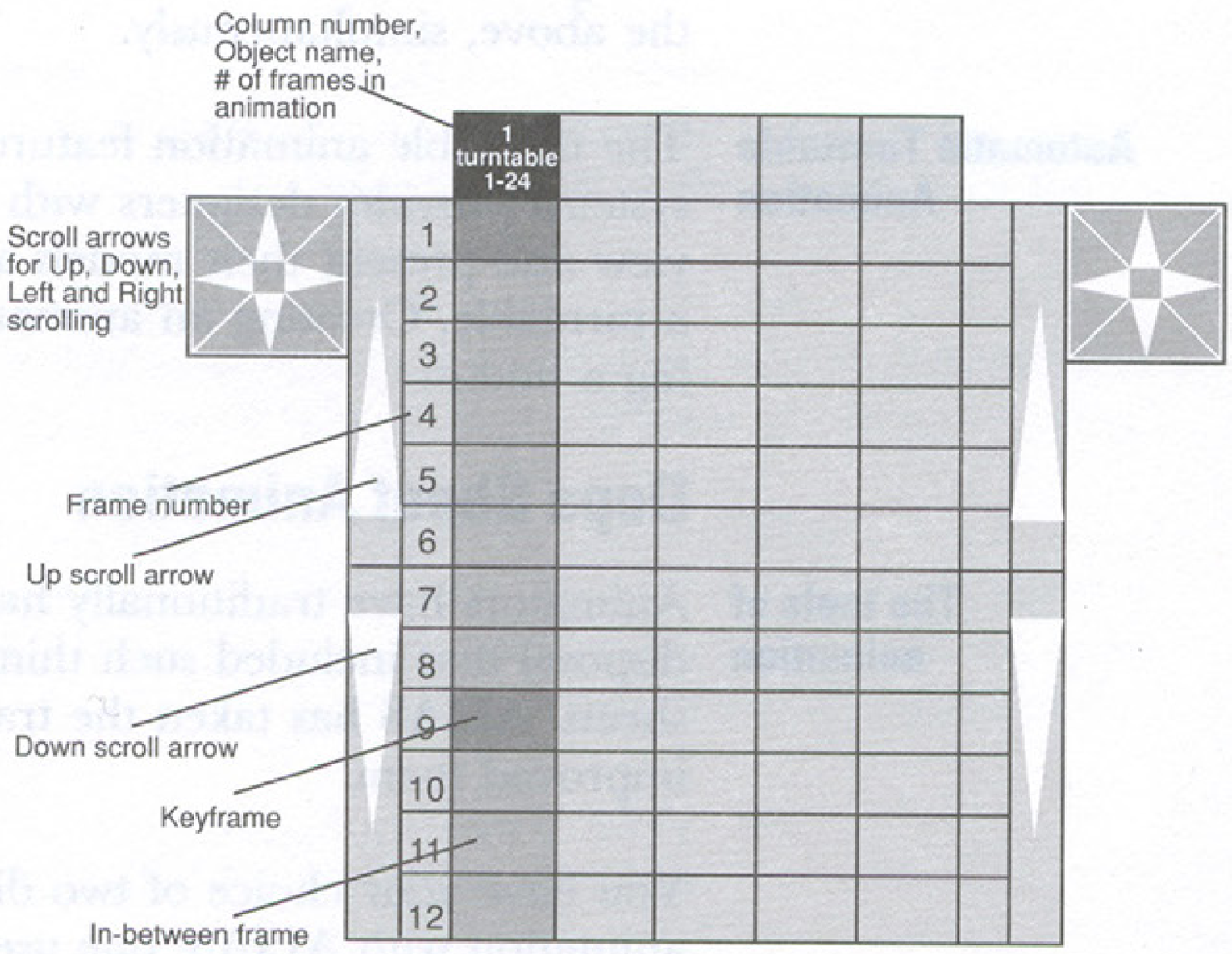
You have your choice of two different systems for animation with ALIAS: one uses a traditional dope-sheet style, and the other uses a powerful parameter-based system.

Camera

ALIAS *cameras* let you view your scene exactly as if you were looking through the lens of a camera. By animating your camera (shown as a camera icon on the perspective window), you can fly over, around, under, and even through your scene or object, so that you get a full 360 degree picture of what it looks like. You can also tumble the camera for different angles or zoom in to view details. You can do this through setting keyframes or creating motion paths.

Dope sheet

Traditionally, animators have used an animator's *dope sheet* to keep a record of what happens when, and to what object or component. The dope sheet found in some ALIAS products is a record of the entire animation. ALIAS has brought this easy-to-follow tradition into the computer with the ALIAS dope sheet. Each horizontal row within this sheet represents a single frame and each vertical column represents a component, object, light, camera, or group of objects and their transformations over time.



Keyframes

The process of animating a scene would be daunting if each frame had to be individually created by the animator. In ALIAS, the process is dramatically shortened by the use of keyframes. A keyframe is a significant moment that represents the beginning or the end of a particular motion.

An animation sequence on videotape that lasts a minute would have 1800 frames (videotape requires 30 separate frames per second of motion). However, depending on the movement happening in the scene, it could have as few as two keyframes, one at the beginning of the action, and one at the end. The animator can assign the objects to their places for the keyframes, and let the computer automatically calculate the motion between these frames. This process of calculation is called *in-betweening*.

In-betweening

You select the keyframes that establish the beginning and ending positions of a change in motion, scale, or rotation of each object in an animation. The keyframes are then displayed in dark blue on the dope sheet, to help you distinguish them from the other frames. The frames that lie between these points are interpolated by ALIAS and are automatically inserted into the dope sheet by the system. They are displayed in light blue.

Fine tune with ALIAS

Once the computer has calculated the frames between the keyframes, you may want to fine tune the motion in your animation sequence. With ALIAS, fine-tuning can be accomplished in several ways: through the use of parameter curves, motion paths, or timing curves.

Parameter Curves

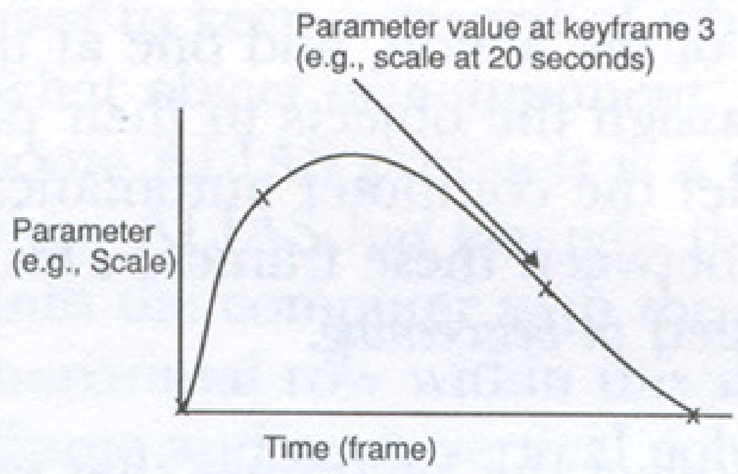
Parameter curves control the position, scale, and rotation of objects in your animation.

A parameter curve is a two-dimensional graph with CVs that you can manipulate, similar to any other curve. The coordinates for the graph are **Time** on the horizontal axis, and the corresponding **parameter**, be

it scale, position, or rotation in x, y, or z direction, on the vertical axis.

This means you can represent acomplete animation on a set of graphs that you can fine tune accurately.

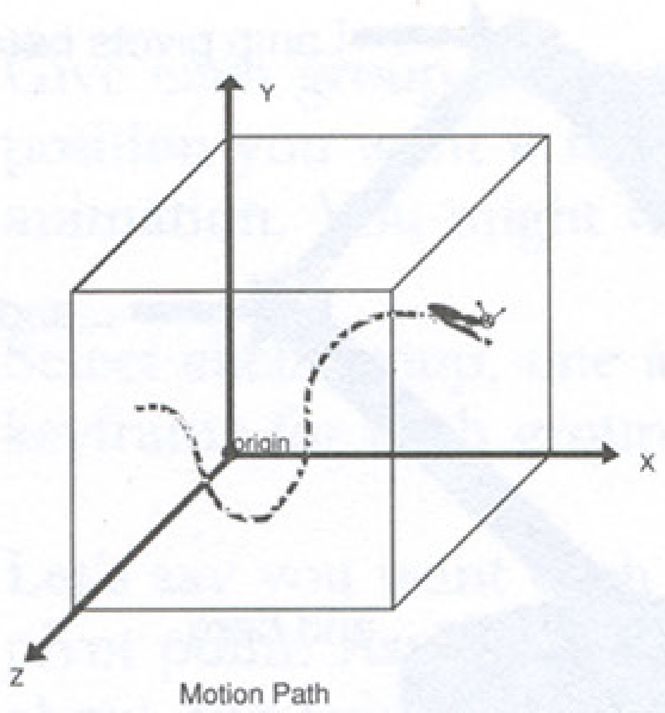
If you have an object moving from point A to B and back to A, and it takes 20 seconds to move, you might decide that the object moves quickly to the destination point B, and returns slowly back to point A. The parameter graph would look something like this:



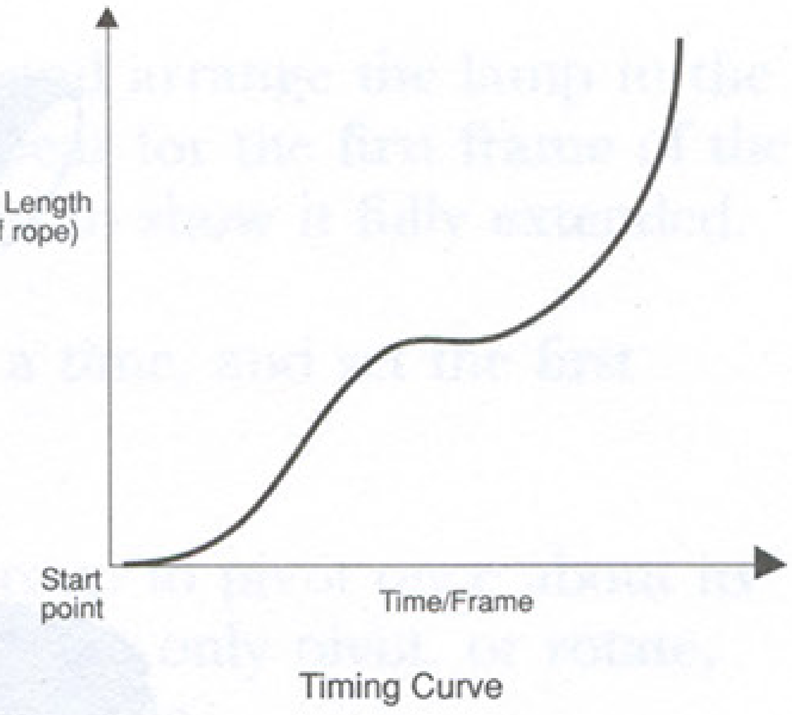
Motion path, Timing curve

Using a motion path and its timing curve allows you to control position separately from time. As well, a motion path helps you visualize an object's 3D position. Two curves are used: one to describe the value in 3D space as a curve, and the other to describe the point along the curve as a function of time.

Consider animating an ant walking along a rope. The ant will always be somewhere on the rope. Therefore, the rope's position in space is also the motion path for the ant. Where the ant is at any given moment is described by the timing curve. As illustrated on the next page, the ant gets a late start, travels quickly more than half way, dawdles a bit, then finally proceeds to the end at an increasing pace.



Motion Path



Timing Curve

Selecting the Translation Type

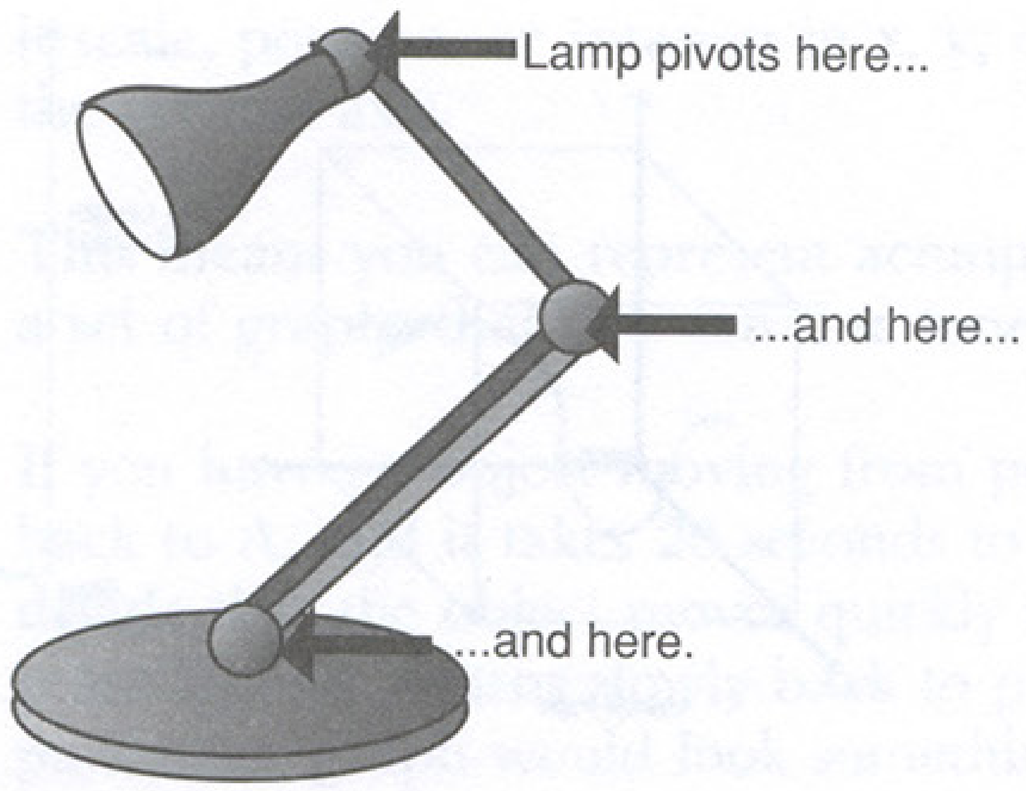
By default, the method of animation (or *translation type*) selected by the computer is parameter curves. If you want to use a motion path instead, simply change the object's translation type to motion path.

Animating the Camera

Camera movements add additional sense of realism to an animation. By zooming, tumbling, or panning (called *tracking*) in the perspective window, you create the initial view and set the initial keyframe. You can then set subsequent keyframes by changing the camera's position and clicking on the new keyframe number. ALIAS will automatically do all the calculation for the in-between frames.

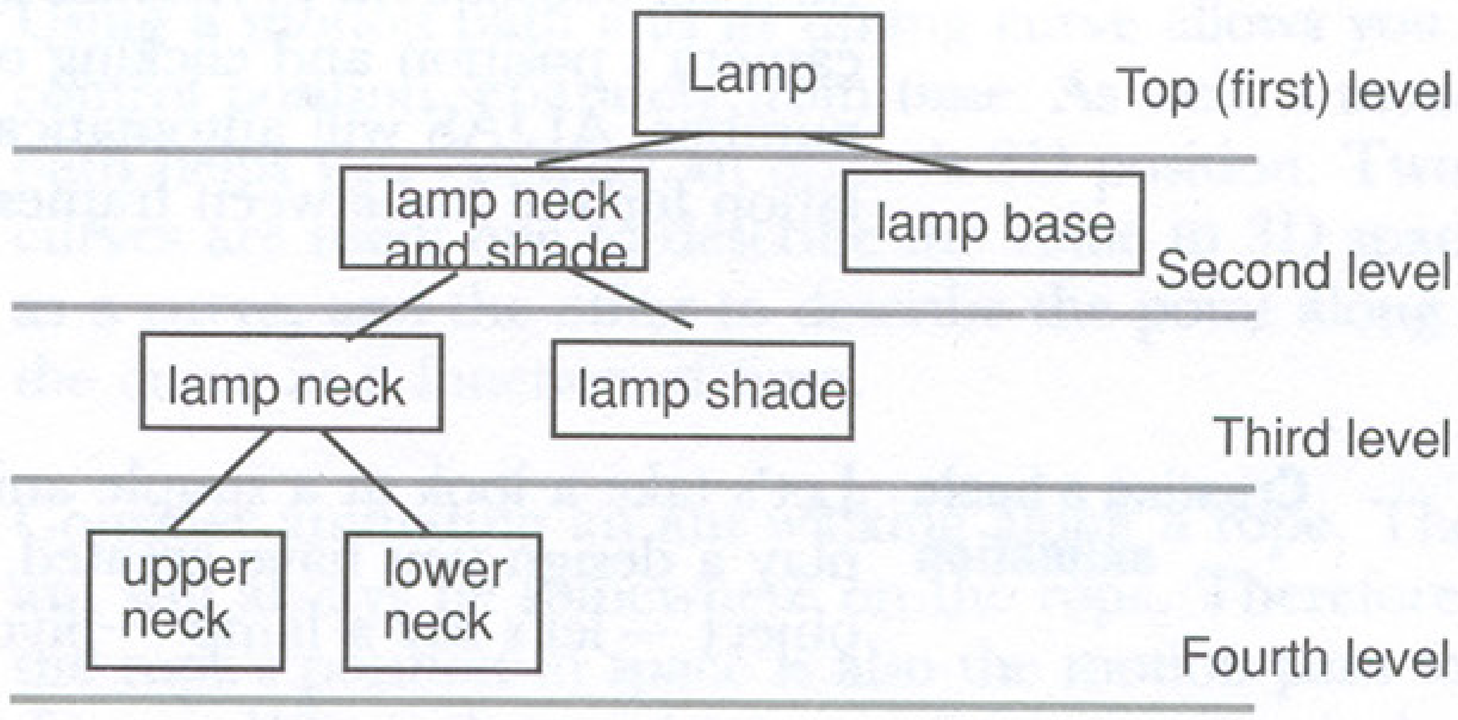
Creating a basic animation

Let's take a look at a simple animation. In order to display a design you have created, you want show your object — let's say a lamp —pivoting about its neck:



This is a simple hierarchical animation task. Smaller groups move within larger groups, and each group has its own pivot point. By creating an animation this way, you'll be assured that each smaller group will "stick" to the larger group, and not float away on its own. This sort of grouping is called a hierarchy.

This object hierarchy has four levels:



- The top (largest) group is the entire lamp. Set its pivot point on the ground in the middle of the base.
- The next sub-group, or component, is the lamp neck and shade, pivoting at the base of the lamp's neck.
- The next group is the top part of the neck, and the shade. It pivots where the top part of the neck meets the lower part of the neck.
- The smallest group is the lamp shade alone, pivoting where it meets the neck.

Give each group a name, and arrange the lamp in the position you want it to appear for the first frame of the animation. You might want to show it fully extended.

Select each group, one at a time, and set the first keyframe for each group.

Let's say you want each group to pivot once about its pivot point. As each group can only pivot, or rotate, about one axis, the task is simple.

Rotate each group, starting with the largest group to pivot, and ending with the smallest, to their final positions. Now select each group individually and set the last keyframe.

It's important to consider how long you want the animation to last. If you're outputting to videotape, it takes 30 frames of animation to create one frame of tape. If you want your animation to last 10 seconds, the last keyframe should be 30 x 10, or frame number 300. Set frame 300 for each of the groups.

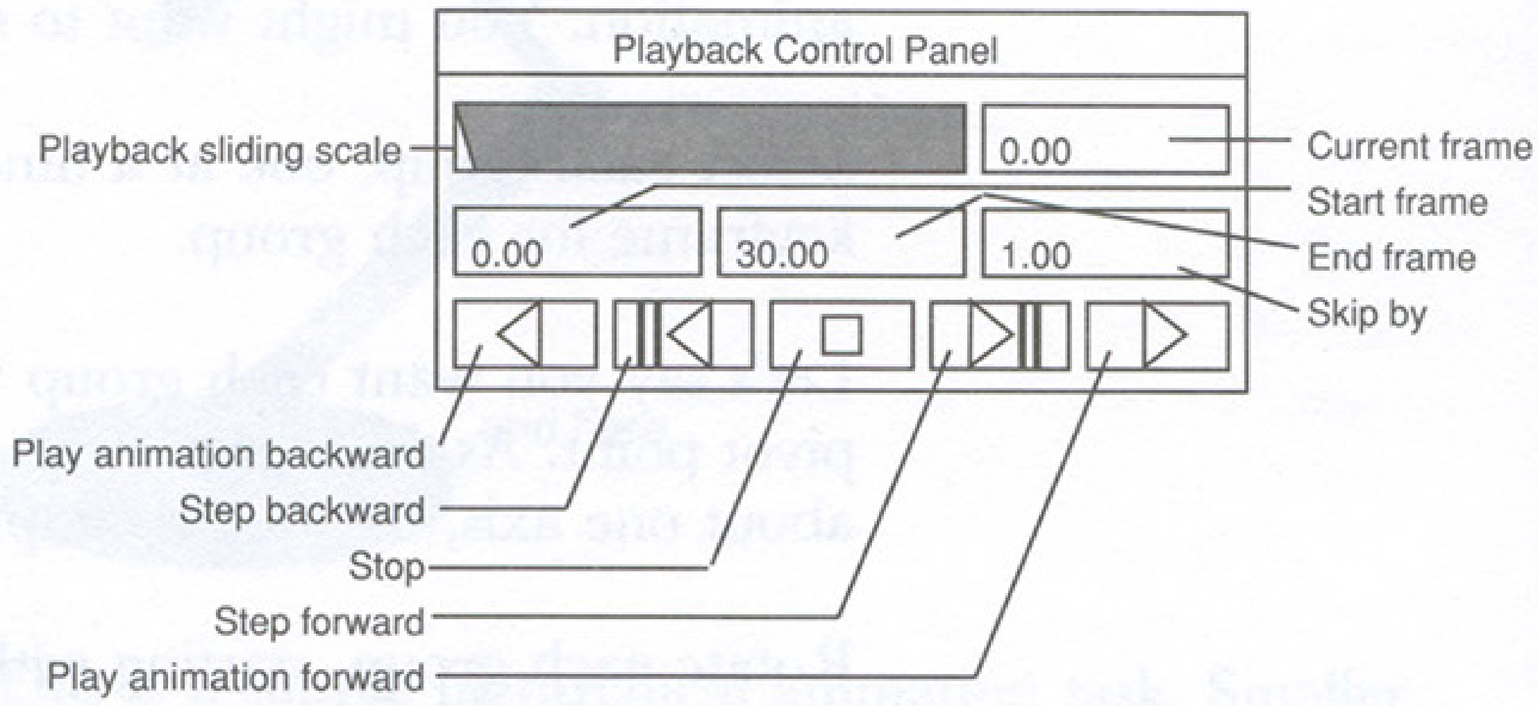
ALIAS in-betweening will create all of the frames between the first and last ones that you set, and the lamp will pivot with a smooth, constant motion. You can change the details of the rotation by adjusting the value curve or the timing curve.

View the Animation

Once an animation is complete, you can view it in the modeler by selecting the beginning and ending keyframes from the dope sheet. You will see a wire-frame animation of your car rotating on a turntable.

Certain ALIAS systems include the Playback Control Panel. Using this, you can watch the replay of your animation and pause between frames. You can enter an individual frame number or use a sliding scale to view the entire animation or just a part of it. It's like using a VCR.

This is what the Playback Control Panel looks like:



Parameter-Based Animation

Several ALIAS systems use a completely Parameter-Based Animation system instead of the Dope Sheet concept.

A parameter based system gives you excellent control over the subtle details of your animation. In a parameter-based system, you can control the values for an item's position, rotation, etc. together or separately. By default, the parameters for an item are controlled together, but you can easily separate them for better control over subtle details. With a parameter-based system, individual animation curves can be treated as entities. Generic animation curves can be stored, retrieved, displayed and edited.

Animation operations apply to active objects or sub-objects (called components) and their hierarchies (if desired) instead of columns of the Dope Sheet.

A complete Animation Menu level combines the animation controls with a subset of modeling functions.

Animating on Fields or Fractional Increments

Animation with fields results in a much crisper animation on video without longer rendering times.

Animation on fields or any fractional increment is also possible. For video, a "field" is every second scan line in a frame. They are usually called the "odd" and "even" scanlines, depending on whether they start at the top line (odd) or the second line (even). This means that frame values in the system can be entered and displayed as fractional numbers.

NURBs as a Motion Path Curve.

Motion path curves are regular geometry and can be drawn and edited using normal modeling tools or copied from an existing curve. You can build a curve, or copy one from a surface and make it a path for selected items. Also, a path curve can be created by setting the positions of the objects in the model.

Store and Retrieve ASCII Animation Curves

The ALIAS animation system is an open system, so you can store and retrieve ASCII files containing animation curves. You can store animation curves from selected items in SDL format. This function has an option that stores the curves as data per frame, so you can move information to other systems using other animation curve types.

Whichever ALIAS Animation System you choose, you can be assured of its ease of use and consistent interface with the rest of the system: that's part of what ALIAS is all about.

Advanced Animation — Metamorphosis

Metamorphosis lets you change the intrinsic shape of an object over time. This gives you the ability to achieve effects, such as squash and stretch, that are found in traditional cartoon cel animations. As well, you can use the metamorphosis capabilities to change one object into another. Metamorphosis is achieved by animating the position of the basic points (CVs) of an object over time. Only ALIAS Metamorphosis lets you animate these points individually.

CVs are animated by moving them and assigning keyframes, just as you would for objects or the camera. Any number of CVs can be animated in a frame.

What is Rendering?

Once you have created a wireframe model, you'll want to give it lifelike colors and lighting. This is called *rendering*. With ALIAS rendering, you can work with over 16 million colors and unlimited surface types and lighting effects to create great pictures. ALIAS gives you the power to produce a full range of image quality for your work. For everything from fast checks on position or lighting to final high-quality RayTraced images that show true glass, ALIAS rendering is the visual presentation solution.

As you prepare to render, a background operation known as the Scene Description Language™ (SDL™) is automatically generated. SDL is a proprietary language developed by ALIAS to easily organize and create an exact representation of everything in a rendered scene, which can be edited if desired. The power of SDL will be discussed later.

Photorealism: Quality vs Time

ALIAS provides a number of tools for rendering your image. Sometimes you don't need a high quality image, but just want a fast thumbnail. With ALIAS, you can create preliminary images quickly. You choose how much time you want to spend rendering a particular image and how lifelike you want it to be.

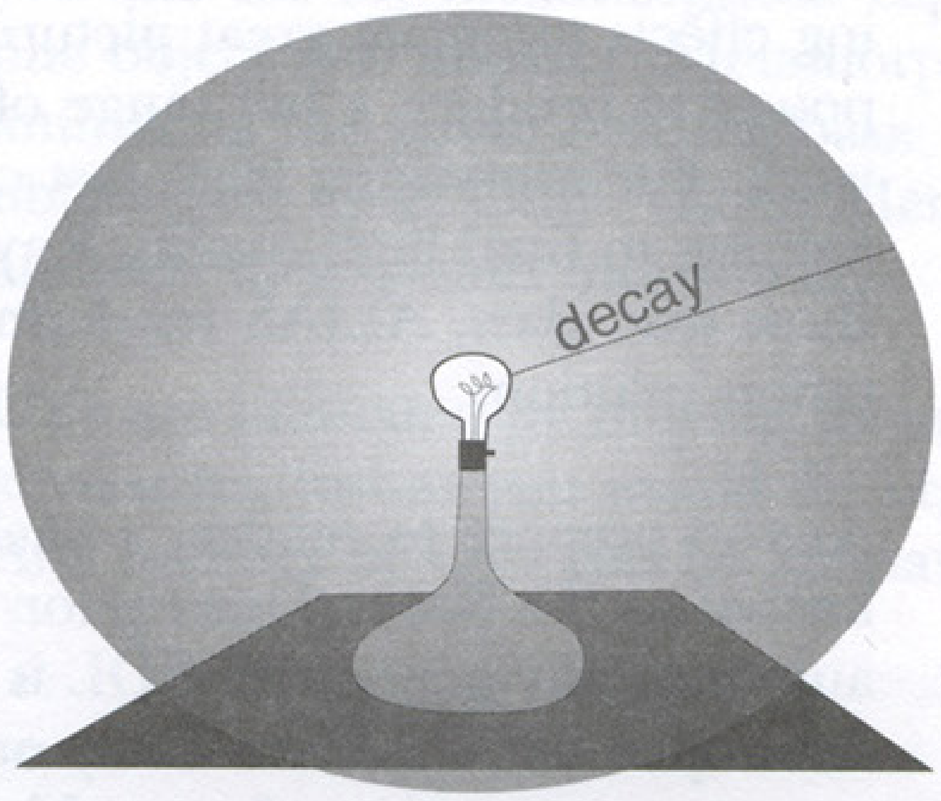
Lighting the Scene

ALIAS provides you with different types of light sources that you can use to illuminate your model: point lights, which are similar to standard incandescent lights, and spotlights. Some ALIAS systems also give you area, linear and directional light sources.

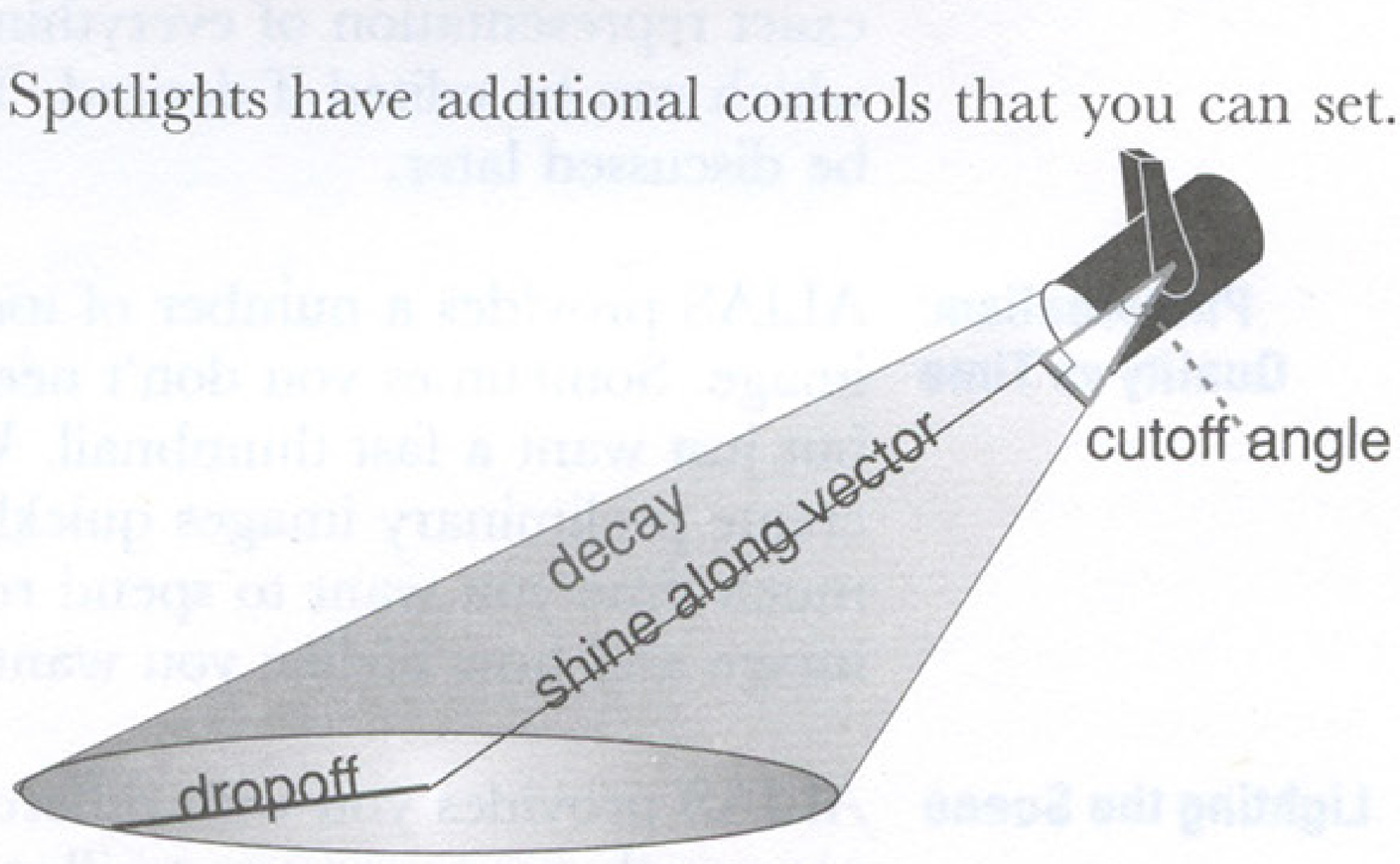
There are several variables that you can easily set to make sure the lighting looks just the way you want it to. You can determine the color of the light. It can be any color that you can create in ALIAS: one of over 16 million shades can be used for each light. Any color that you assign to the light will have an effect upon the

color you have chosen for the highlight of the surface being illuminated.

You can also control brightness (*intensity*) and the length of fade (*decay*).



Spotlights have additional controls that you can set.



The *Shine Along* vector provides the direction in which the spotlight will point.

Cutoff controls the spread of the directed light by specifying the angular measure in degrees between the central axis and the edge of the beam of light, from very tightly focussed to very wide.

Dropoff controls the rate at which light intensity decreases from the center to the edge of the spotlight beam.

Adding Color to the Scene

Before you render your scene, you'll want to add color and texture to it so you'll get the most realistic look at your model as possible. With ALIAS, you can do this interactively, so that you see what you're creating while you're doing it.

Different shading models allow the simulation of different materials. The simplest shading model is called *Lambert*, and is useful for matte surfaces that don't have specular highlights, such as walls painted with a matte paint, or blackboards. *Phong* shading is good for plastics, while *Blinn* shading is most realistic when rendering metals. There's also a *Lightsource* shading model for making objects look like they give off light. For a given shading model, however, a very wide range of physical appearances is possible.

Shaders

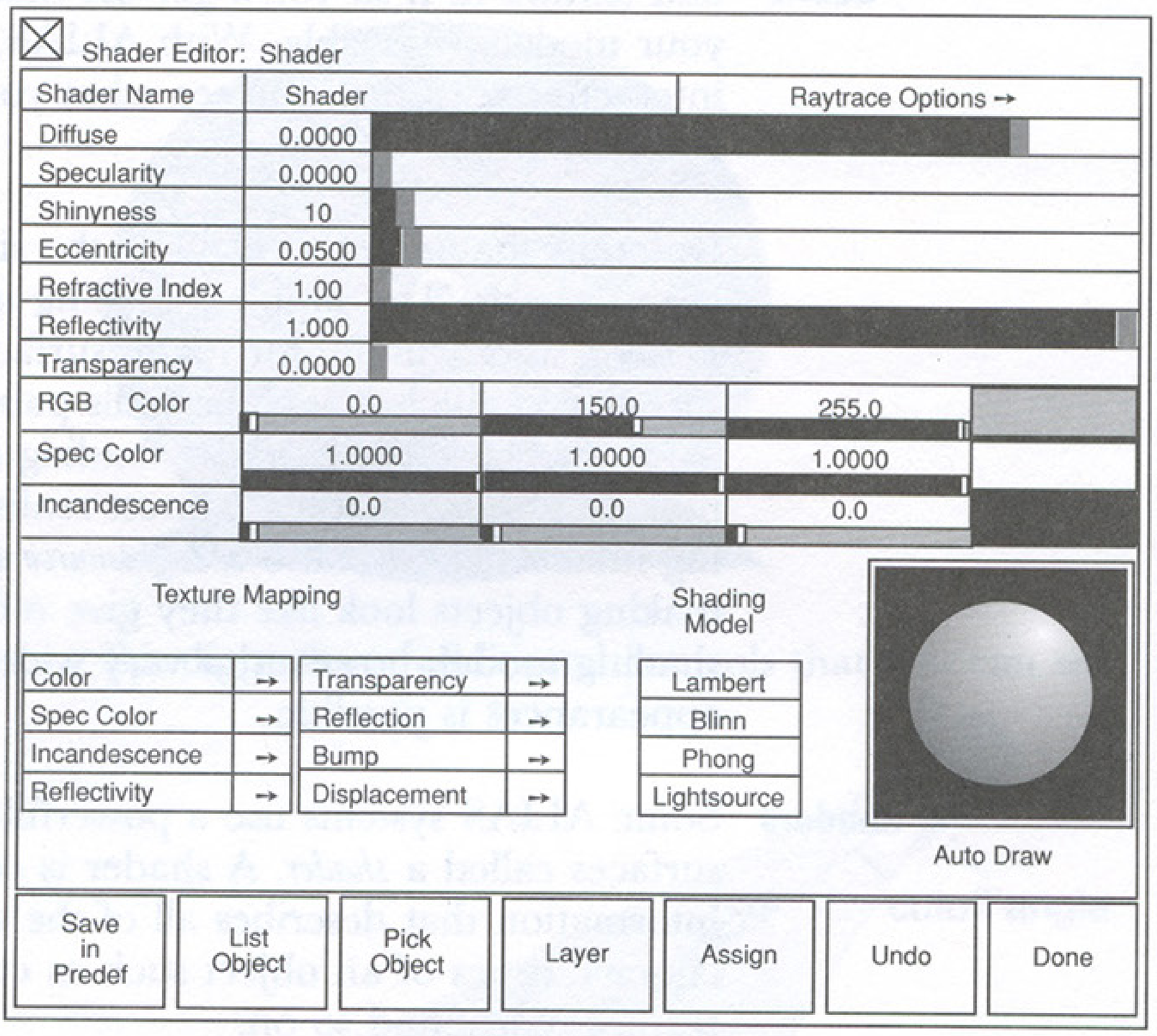
Some ALIAS systems use a powerful tool for defining surfaces called a *shader*. A shader is collection of information that describes all of the surface characteristics of an object such as color, shininess, texture maps, and so on.

When working with shaders, you create or select a predefined shader, then define the relationship between the shader and an object. Predefined shaders can be displayed and selected from a list. This means that you can create a table of your favorite shaders that you use repeatedly, so you don't have to make a new one each time.

The selection and editing of surface characteristics is interactive and easy to use, improving your efficiency and productivity when working with several objects in succession, or when refining the characteristics of an object. You assign surface and three-dimensional textures interactively, and see the results when

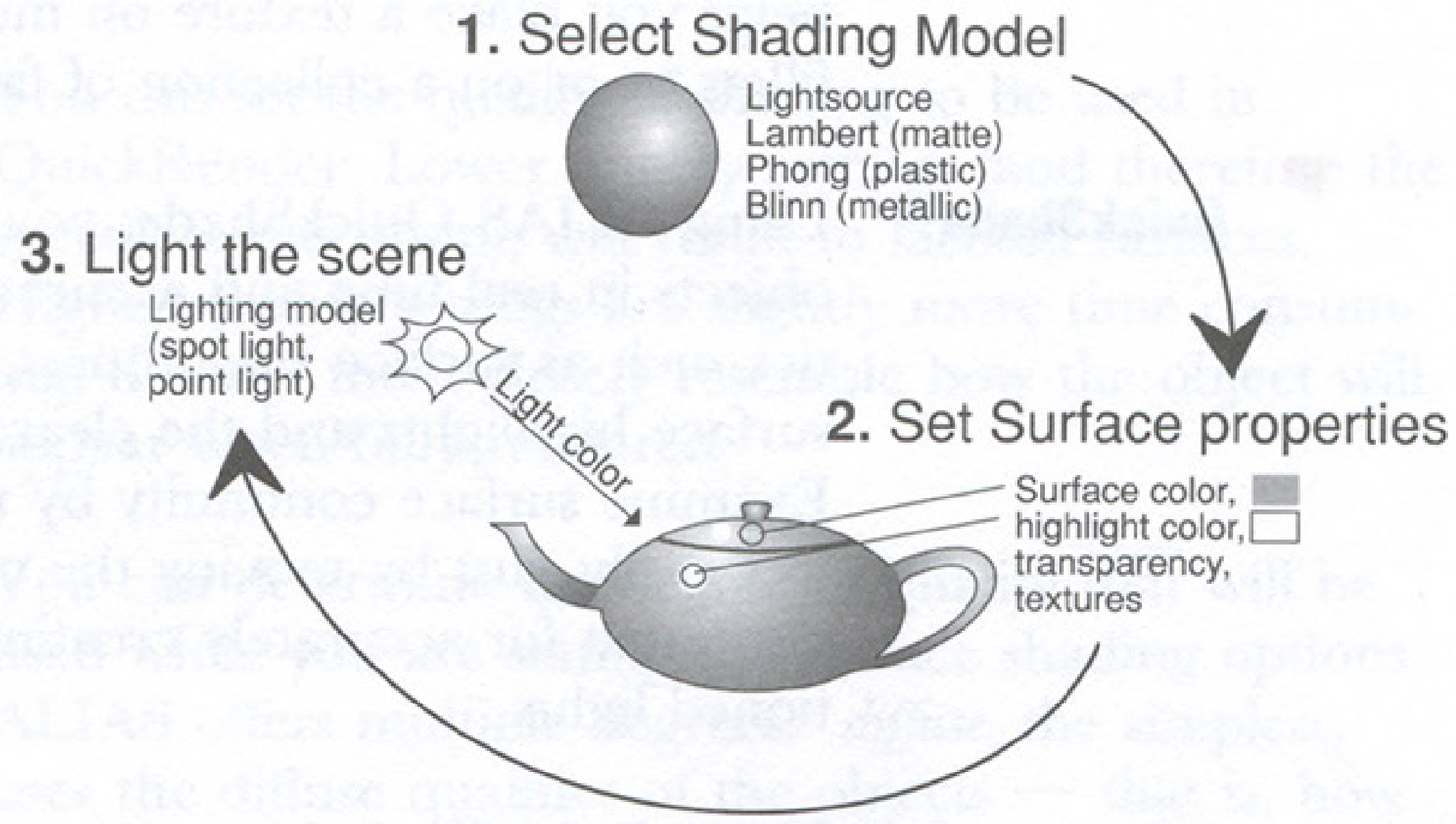
QuickRendering or QuickShading an object, giving you fast and easy control.

The Shader Editor gives you an easy-to-use window you can pop up and move around on your screen:



Creating a shader is simple: click on the options you want, or move the sliding scales with the mouse cursor, choose texture maps, and assign the shader to an object. You select whichever shading model you want, then choose from over 16 million colors for the color and specular highlights of your object .

You usually follow a three-step process for getting your model ready to render:



Applying Texture to your Design

Many man-made and natural objects are not completely uniform in their optical properties. Animals have skin with colored markings, and a leaf may vary in transparency across its width. Most seats are made of wood or covered with fabric. These type of effects may be simulated by a process called *texture mapping*. In ALIAS, it's as easy as pasting a picture in a scrapbook.

Generally speaking, two dimensional texture maps change the color or the transparency of an object. They can even change the shape of an object (bump and displacement maps). A special type of texture map is the *environment map*, which makes the object look like it's reflecting the environment around it. You can create a 2D texture map in a number of ways: by using a scanned in image, an image you've previously rendered, or one created from scratch using DesignPaint.

Leather, mountains, canvas, stained glass windows: all can be created easily using texture mapping techniques.

World Space Texture Mapping

World space texture mapping improves the realistic appearance and image quality when the texturing of fabrics, labels, stripes, and so on, is required. ALIAS makes it possible to map the texture while seeing the world space dimensions of the texture with less distortion than other methods provide. This feature also

helps you place a texture on multiple surfaces, such as fillets or or on a collection of faces, such as text.

QuickShade™

Using ALIAS QuickShade, you can move fully shaded objects in real time and accurately evaluate characteristics such as surface smoothness, intersecting surfaces, surface highlights and the clearance between objects. Examine surface continuity by rotating the shaded object easily, just by moving the mouse. QuickShade is also great for accurately creating colored and positioned lights.

Using QuickShade is easy: just select it from the Display Tools button. Once the objects have been shaded, you can perform almost any function that you would with a wireframe object and see the results on a fully-shaded model. When using the perspective window, you can change the camera by panning, zooming, or changing the lens angle. You will be able to see the result on your scene immediately. Additionally, you can move lights around the model in real time, to see how different lighting will affect surface appearance.

QuickRender

QuickRender works in the Modeler while you watch. You can quickly check the colors, lighting, position, and textures without waiting for a final higher quality render.

QuickRender is useful for quickly:

- checking surface continuity
- examining the placement of objects in a scene
- setting lights (both point light sources and spotlights)
- correctly placing textures (for label mapping, etc.)
- exploring different surface qualities of an object

QuickRender Options

You have a number of choices within the QuickRender option that let you select the functions you want to have. You can use either the modeling window (grey grid pattern), or if you have a background scene you want to use behind your model, you can have that automatically QuickRendered into the new scene.

You can set the quality of shading to be used in QuickRender. Lower quality settings (and therefore the speediest execution), will result in faceted surfaces. Higher quality settings are slightly more time consuming, but will more closely resemble how the object will appear when fully rendered.

You can determine the degree of quality that will be used while you are setting the surface shading options. ALIAS offers multiple degrees: *diffuse*, the simplest, uses the diffuse qualities of the objects — that is, how the light is scattered on the surface of the object; specular highlights (mirror-like reflections of light) are added with the *specular* setting; and textures are rendered when the *texture* setting is chosen.

You can also use a predefined general purpose light (known as the *Sun*), which is useful when you are initially setting and choosing the colors in your scene. You can use either the Sun setting or lights that you have placed in the scene.

User-selectable Subdivision

You can increase or decrease the surface smoothness of your QuickRendered or rendered image by altering how finely you subdivide your surface. Only ALIAS offers interactive adaptive or standard subdivision setting on a per-object basis, or for the whole scene.This can be set and modified at any time, to let you focus in on one object in particular while having the rest of the scene rendered at a lower surface quality level.

RayCasting and RayTracing

Photorealism gives accurate insight into and understanding of a proposed design. ALIAS uses two different methods for producing realistic images: RayCasting and RayTracing. How do they differ? First, we'll look at the simpler of the two: RayCasting.

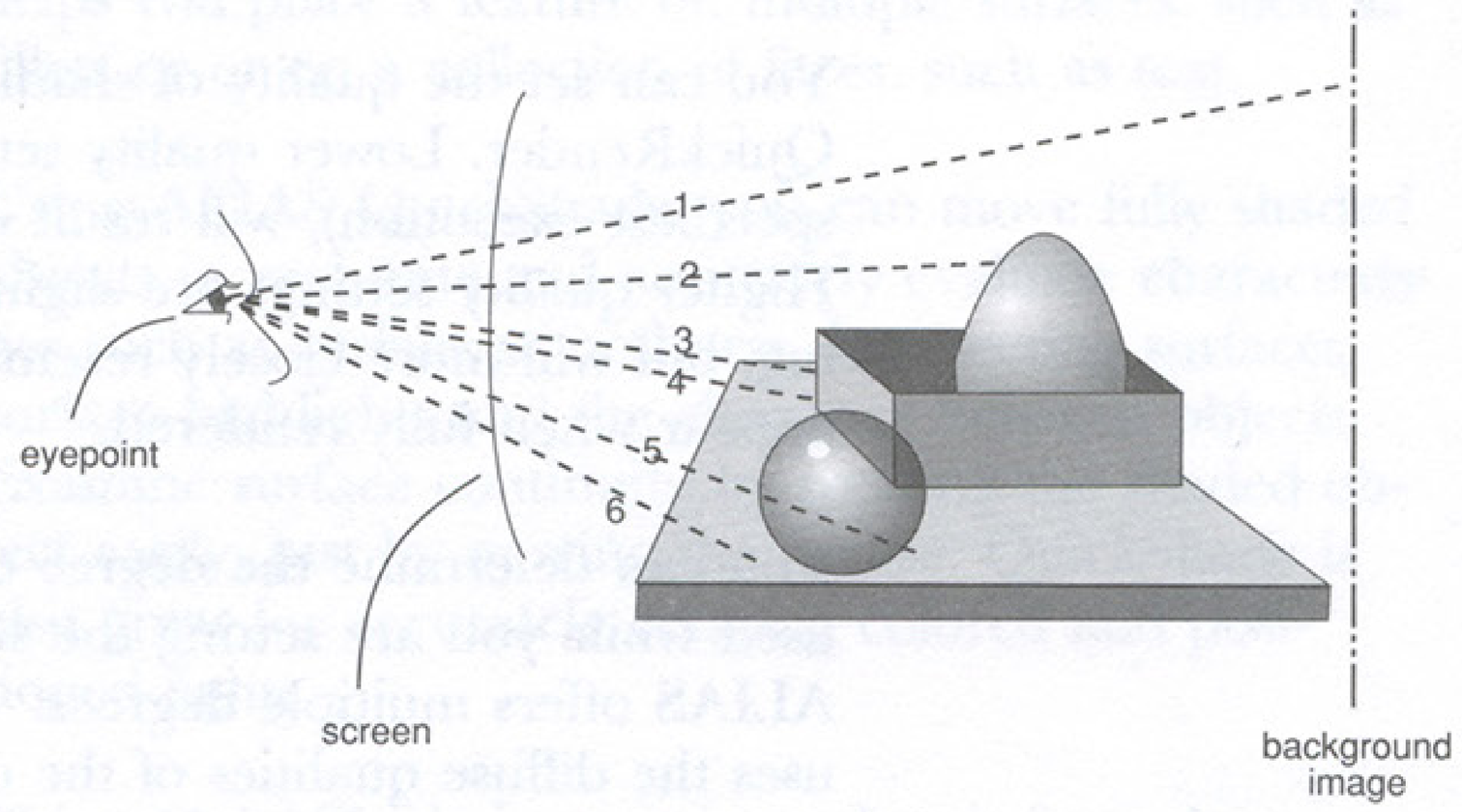


Figure 1: RayCasting a scene

RayCasting

The display screen of your workstation is similar to a piece of very finely ruled graph paper with over a million small squares. Each small square is drawn in a solid color. These squares are called picture elements, or *pixels*.

For each pixel on the screen, one or more straight lines (rays), are projected into the scene from the camera (eye point). The rays strike objects in the scene, and the light that is reflected off of each object at that point is calculated.

Ray casting takes more time than either QuickRender or QuickShade, but provides higher quality results.

In the illustration, ray 1 strikes no objects until it hits the background image. The pixel at that place where ray 1 intersects the screen will be given the color of the background picture, or a color that you've specified as a background for the image.

Ray 2 strikes the egg, rays 3 and 4 the box, and ray 6 strikes the table top. All of these colors will be calculated and placed in the pixels on the screen, taking into account your choices for how shiny the objects are, if

the objects have been given textures, the lighting conditions, and whether or not a special effect, such as fog, is used.

Ray 5 presents us with a slightly more complicated case: it passes through a translucent sphere and then comes to rest on the opaque tabletop. The ALIAS RayCaster calculates the color for that place on the table, and then adds to it the amount of color it would get from the translucent sphere.

Once a particular ray has been processed completely, the result is a single *RGB* (red, green, and blue) color value. This may be placed directly into the pixel locations, or many rays can be computed and averaged to give a representative color for the pixels. This averaging over many rays per pixel is called *antialiasing* and helps to smooth the edges of objects by blending colors at the edges. When you use ALIAS, you can specify the amount of antialiasing, the pixel dimensions, the shadows to be created, and the camera characteristics.

RayTracing

Now that you know what RayCasting is, we'll tell you that it's similar to the higher-quality RayTracing, but somewhat less realistic. RayTracing is similar to RayCasting in many respects, but has one significant difference: the ray of light doesn't necessarily stop when it hits an object. It can bounce onto another object, and from there, on to yet another, and another, tracing and reflecting everything it sees in the scene. ALIAS RayTracing traces the ray of light as many times as you want it to. More time-consuming than RayCasting, RayTracing gives you the most realistic image possible.

Why would you want bouncing rays? They automatically give you realistic, accurate reflections on surfaces. ALIAS lets you pick which objects in a scene you want to have reflections, to save time in rendering.

RayTracing gives you:

- true reflections from reflective surfaces
- true refraction through transparent surfaces like glass and water
- true shadows from any light source
- definable shadows through transparent objects
- accurate depth of field with a defined focus point.

RayTracing is a rendering process in which imaginary rays of light are traced from the eye point towards the scene. These rays that come from the eye point are called *primary rays*. When and if one of the primary rays intersects an object, the ray may reflect and/or refract according to some simplified optical properties. These bounced rays are called *secondary rays*. The secondary rays are traced in the same manner as the primary rays, and so on.

Shadows are also computed by tracing rays. Each time a ray intersects an object, a shadow ray is traced from that point toward each light source that casts shadows. If the ray strikes another surface before reaching the light, then that point is in shadow with respect to that light source.

Let's take a look at what would happen to ray 5 of the RayCast example if it were RayTraced:

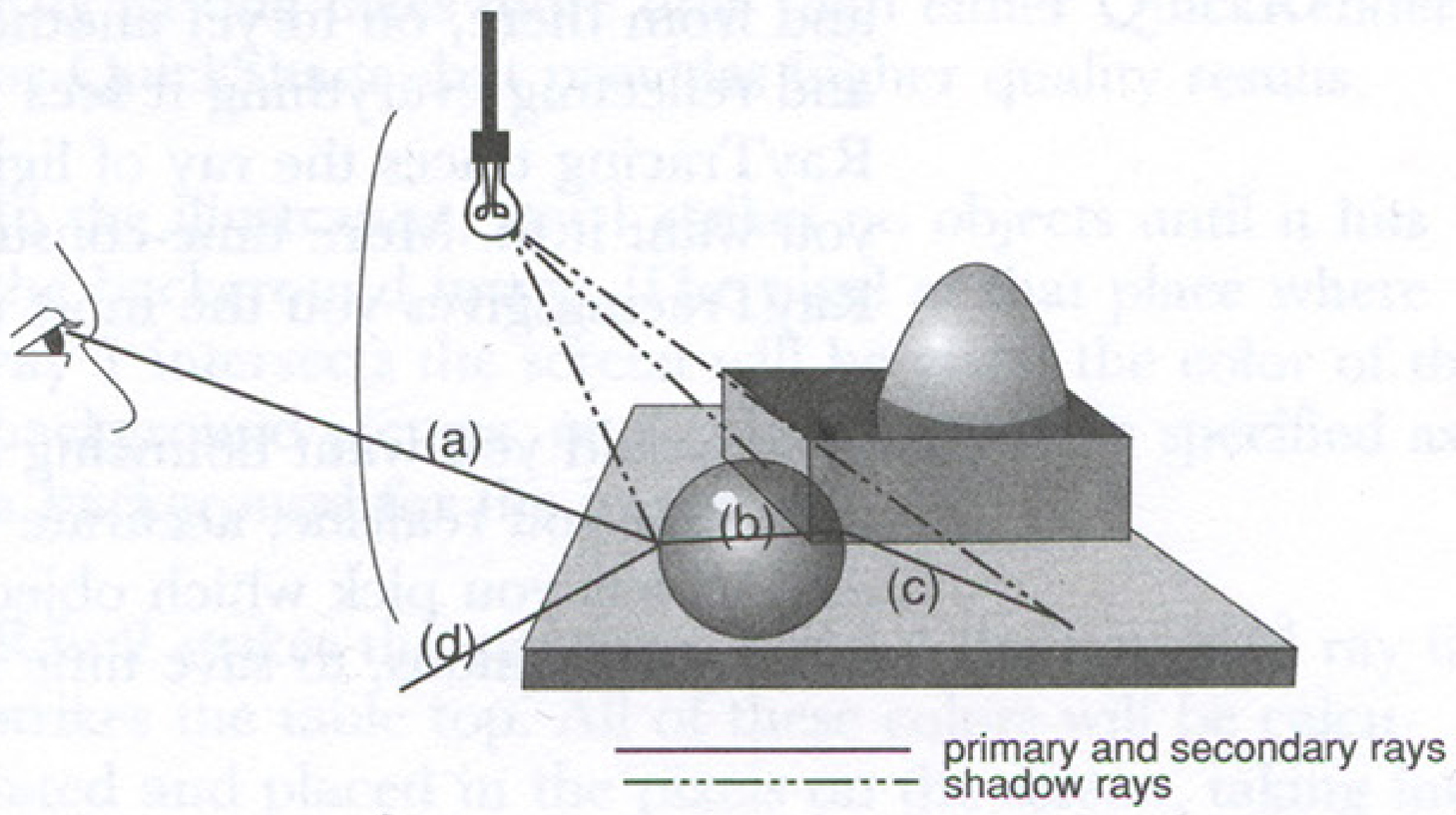


Figure 2: RayTracing a scene

The ray (a) travels from the eye to the sphere. At the point where it contacts the shiny translucent sphere, it splits into secondary rays, one of which (b) refracts through the sphere (that means it is bent at a slightly different angle because of the properties of the material the sphere is made of), and the other (d) which reflects off the sphere until it hits some other object in the environment. The reflected ray will then pick up the color of what it has contacted. The refracted ray (c), once it has traveled through the sphere, then exits the sphere and is refracted at another angle until it contacts the table. It then picks up some of the color of the table. ALIAS RayTracing then takes all of this information and automatically calculates the color that will appear at the pixel where the camera meets the screen.

ALIAS RayTracing lets you limit the number of bounces or secondary rays that may be generated from an intersection with a surface.

Atmosphere

ALIAS achieves effects such as fog to add realism to your images.

A shading effect is the result of the interaction of light with a surface. The shading calculation occurs when a ray intersects with a surface. An atmospheric effect, on the other hand, is what happens to a ray when it travels *between* surfaces. In a perfect vacuum the ray travels without any light being scattered along the path of the ray from the light sources. This is typically the case in computer graphics images. A clear, hard look results.

However, in real life, dust or smoke particles float in the air. They obscure distant objects and scatter light to produce a mist color.

Fog

Constant density fog has equal densities of particles at all locations in space. Distant objects fade equally in all

directions. The view in any direction blends to a constant color if there are no obstructing surfaces.

Layered Fog

Layered fog, on the other hand, has a density that varies with the altitude. In a mountain scene viewed from above, the valleys may be filled with fog while the peaks are crystal clear. In fact, there may be several layers of fog with clear air between them.

The second important attribute of smoke or fog particles is the way that they scatter light. Small particles scatter light in a way that depends on the light's wavelength.

Air molecules scatter blue light more than green or red light. This means that a beam of white light viewed obliquely through the air will appear blue. Indeed the sky, looking up, is blue for exactly this reason. However, a white light viewed directly through the air will appear yellow, since the blue light is being scattered along its path. For an outdoor scene during the day, the fog color is white, but the optical depth for blue is less than that for green or red. Surfaces that are close to the eye will just have their own color. Surfaces that are in the middle distance will have a bluish tint to them, while very distant surfaces will disappear into a white mist.

What is "Natural Phenomena?"

Alias Natural Phenomena gives you the power to create images that rival the real world in detail and depth. It is a unique and powerful method of presenting advanced non-geometric rendering. Natural Phenomena is a set of predefined procedures for realistically creating:

- solid textures
- sky
- clouds
- mountains

- water
- atmosphere
- 2D procedural textures

Solid Textures

With Natural Phenomena, you can make objects of solid wood or stone. And you are not limited to one type of wood or stone. With the solid wood procedure, you can make anything from ash to zebra wood, to oak, maple, or mahogany, just by choosing the colors and the grain. This also applies to the solid marble procedure: in addition to marble, you can create onyx, agates, jades, granites, and more — almost any type of stone can be simulated using this procedure.

You can also place objects in a real environment with Natural Phenomena: you can create a mood that compliments any given product. Add drama with a sun rising over your product, or snow-capped mountain peaks off in the distance.

Basic Fractals

Some objects in nature, like clouds, snow, and fog, do not have well-defined surfaces, boundaries, and densities. This makes it difficult to model them mechanically. Natural Phenomena accurately simulates these effects by using fractal mathematics and predefined variables that you control.

Fractal mathematics lets you move in on an object, such as a cloud, while still keeping the level of detail you'd expect to see when you get close to a cloud — as in an airplane. Using fractal mathematics ensures that you'll never get blobby clouds or an inappropriate level of detail in a mountain scene, regardless of how close or far away you place the camera.

All you have to do is use one of the ALIAS procedures that creates the beautiful effects seen in nature: mountains, snow, clouds, and solid textures such as wood and marble are some of the procedures that use fractal mathematics.

Sky The sky procedure generates images of a planetary atmosphere as seen from the surface of the planet. There are variables for controlling the composition of the atmosphere and the cloud layer.

Clouds Clouds are scaled and positioned using a number of variables that you can set. The clouds are lit in several different ways. The first is the ambient scattered light from the atmosphere. This depends on the sun elevation. The second form of illumination is direct back lighting from the sun. This is most noticeable near the edges of thick clouds or on thin clouds. The third form of illumination of the clouds occurs when the sun is below the horizon and the clouds are front lit. This is a very subtle effect and occurs only briefly in nature.

You can select the range over which the cloud goes from being opaque to being transparent. You also control the contrast or fluffiness of the cloud by scaling the fractal noise function.

Mountains ALIAS provides you with two different procedures for creating mountains: MountBW and MountRGB. MountBW uses fractals to create mountains out of flat patches. Options provided with MountBW let you put snow on the mountain peaks — and you can determine how far down the snow will go, its roughness, and how ragged the boundary is between the snow and the mountain.

MountRGB, when used in conjunction with MountBW, gives you the ability to color the mountains and the snow as you wish. In some ALIAS packages, these two procedures are combined into one.

Water The Water procedure is used to produce realistic water effects. If it is used as a bump or displacement map, the result will resemble water waves and ripples.

2D Procedural Textures

Natural Phenomena also provides you with a number of commonly used procedural textures for creating bulges, checkered patterns, and grids. All of these have variables that you can easily alter to suit your image.

Grid Textures

For example, the colored grid texture lets you define the color and width of the grid, the color and size of the rectangles, and how many rectangles there will be in each direction.

Bulging Textures

The Bulge texture was inspired by looking at windows on a sky scraper. If the building were pumped full of air, the glass would bulge outwards in the center while the edges would be constrained by the frame. The frame of the window is exactly the same as a grid, and is user-specifiable. You can scale the amount of bulge, making it as large or as small as you want it to be. Bulge is particularly recommended for use as a bump or displacement map, although it can also be used as a transparency map for windows that are dirty and opaque around the edge and transparent in the middle.

Advanced Rendering with SDL™

An image contains a great deal of information. Looking at a picture, the eye sees a two-dimensional representation that the mind is able to understand in terms of the world we inhabit. We are able to draw conclusions about the types of objects an image contains: their geometry, textures, colors, positions, and relative scales.

From the way the light behaves in the image, we can frequently determine the source or sources of illumination, and the qualities belonging to those light sources: how bright a given light source appears to be, the color of the light, and, if we have experienced that type of illumination before, we can often tell what type of light it is; for example, candle light looks very different from the light given off by an incandescent bulb, a fluorescent tube, or the sun.

From the way the light behaves between objects, we are able to interpret some of the qualities of the atmosphere: the humidity, the dust level, and perhaps even some aspects of its composition. Taking an image into the fourth dimension by animating it gives us yet more information: from the movement of objects we may be able to get an idea of their mass, elasticity, or other properties. Finally, from looking at an image,we can tell our physical relationship to the scene that we are viewing.

How can all this information be represented in a computer language in a meaningful way?

Scene Description Language™ (SDL™)

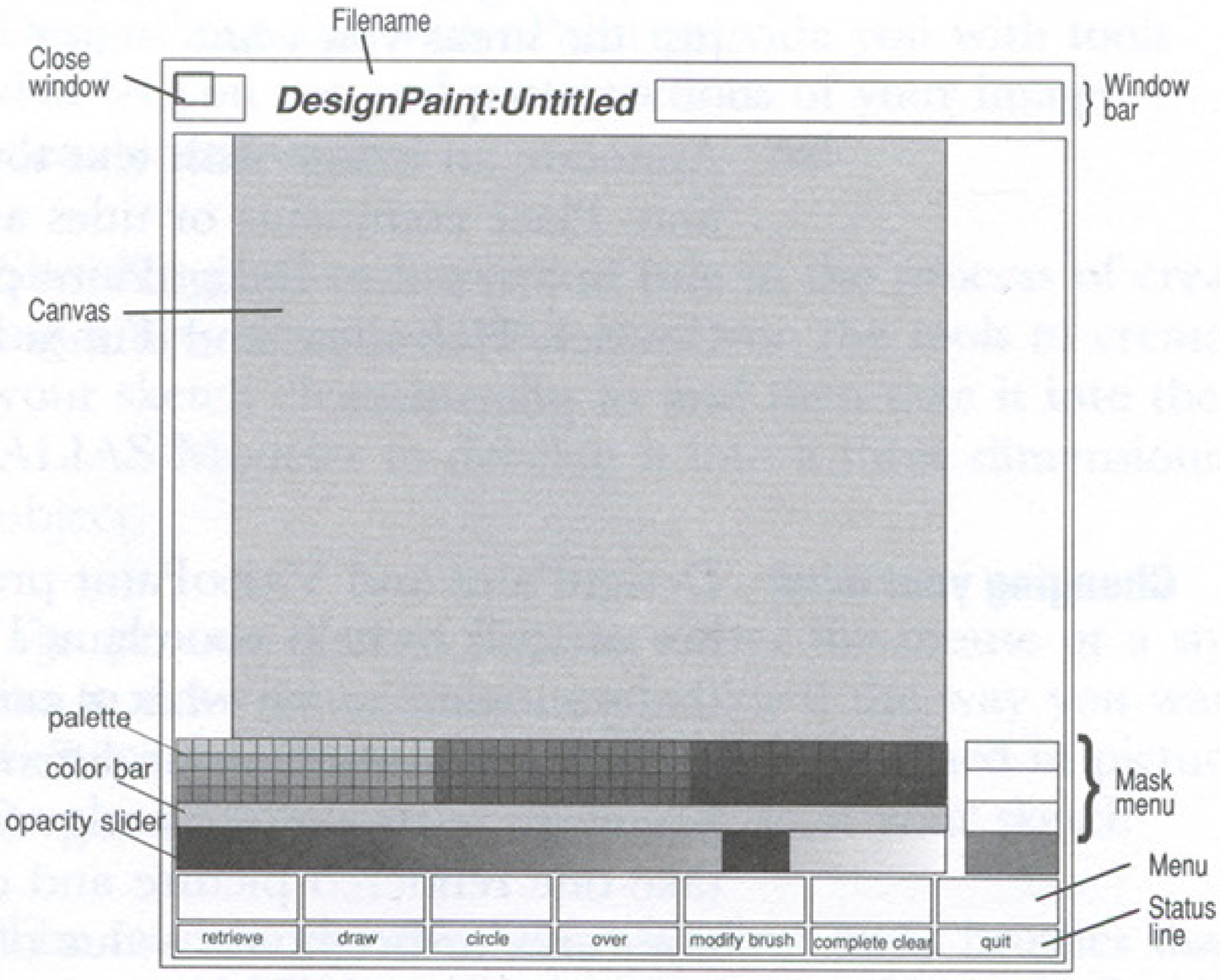
SDL was created by ALIAS as a method of organizing the exact representation of every element of a scene: objects, lights, surfaces, camera position and direction, the background, animation — all of this is organized in an easy-to-follow manner in SDL. The power of SDL lies in its ability to compactly organize and then execute the information needed to create a rendered picture. Because SDL is an English-based language, you can make changes directly in your files.

DesignPaint™ and VideoPaint

DesignPaint and VideoPaint are high-resolution paint box software created with the designer in mind. They are completely integrated with ALIAS, giving you the freedom to add finishing touches to your rendered images, make changes, do initial sketches to use in the modeler, or create textures to use when rendering.

You work with up to 16.7 million different colors. And a lot of DesignPaint's tools are similar to physical tools that you may be familiar with. You have a choice of canvas size with VideoPaint: 512 pixels square (useful for texture mapping), NTSC and PAL standard canvases are all provided. The size of the image you create or modify with DesignPaint is limited only by your empty disk space.

When you initially start up DesignPaint or VideoPaint, you'll see the following screen:



Touching up your work

Occasionally you may want to change a rendered image, or add special effects to it. Or maybe you've just changed your mind about something and want a quick look at it before you redesign the object.

Sparkles Create sparkling highlights on your images by using the pattern brush. After you design the pattern you want, just click on the highlighted areas of the image that would be likely to sparkle if your image were photographed through a cross-hatch camera filter.

Gleams Add gleaming highlights with a touch of an air brush. For extra safety, you can easily mask areas of the image you don't want changed. And if you do happen to make a mistake, you can always retrieve the last image you saved to try again.

Blur or Sharpen Blur out unwanted detail easily, or increase the contrast in sections of the image: it's all up to you. DesignPaint and VideoPaint give you the choice of blurring or sharpening an entire image, or using those effects on just the areas you want.

Text Annotate an image with text to clarify your presentation. Place comments or titles anywhere on your image, and in any color. DesignPaint provides you with Courier, Helvetica, and Times Roman fonts in a variety of point sizes.

Changing your mind

DesignPaint and VideoPaint provide you with a number of tools to help you change your image. Let's say that you want to see what a car that you've designed looks like in a number of different colors. Instead of having to re-render the image for each color, you can take one rendered picture and change the hue, saturation, and/or brightness value of the car — without losing detail on it. Value is the amount of light the color reflects, the hue is the color of the light, and satu-

ration is how much of the color there is (as if it were being mixed with white paint).

Hue You can change just the hue of the object by selecting the ***hue*** application method, and you can accurately view the hue you will be painting by using the hue slider. Similarly, you can change the value or saturation of the color of an object on the canvas.

Saturation brush Using ***saturation*** , you can reduce the amount of color in an image or part of an image (all the way to black and white, if you wish), or increase it to the point of super-saturation.

Hue + sat brush This function could be used for changing a Granny Smith green apple to a ripe MacIntosh, or for changing a bright yellow car to a grey-green color.

Value brush You can brighten or darken an object using the value operator.

Crop and Paste DesignPaint and VideoPaint provide you with tools that let you cut and paste sections of your image cleanly and easily.

Sketching Sketches play an important role in the process of creating a new design. ALIAS gives you the tools to create your sketch electronically — and then take it into the ALIAS Modeler to develop it into a three dimensional object.

The process is easy. Just use either the mouse or a stylus to draw your design, and color it the way you want. For special effects, you can bring in scanned-in pictures or already-rendered images as part of your sketch.

The toolbox provides you with four basic brushes that you can modify to suit your purposes. You can develop your own set of favorite brushes and create a variety of

different effects, as well as mimic the effects produced by airbrushes, felt markers, chalk, pencils and pastels.

Compositing

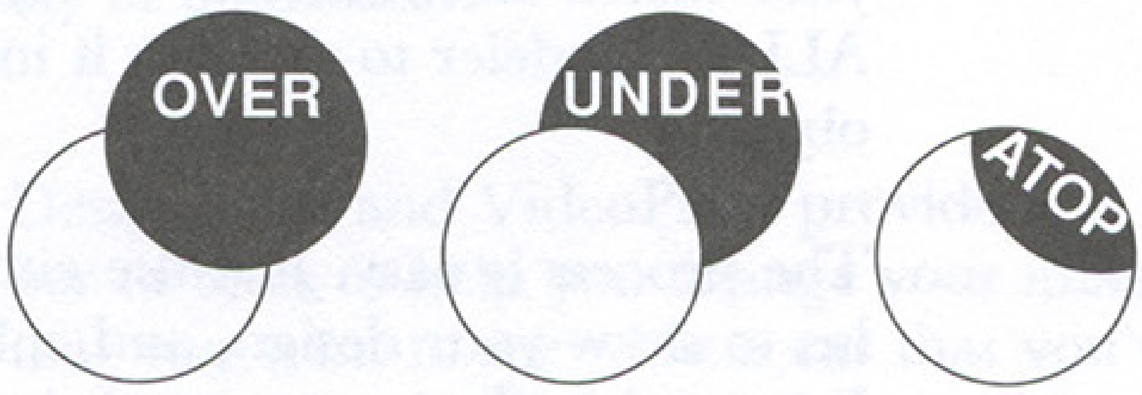
Compositing is the art of combining several images onto a single image. Whether or not we recognize it, we are surrounded by composited images. Among the first we come into contact with, as children, are the matted cels used in animation for the Saturday morning cartoons: animated mouths, eyes, and limbs are matted on top of heads and bodies, which in turn are matted over backgrounds.

One other popular use of matting seen today is in print advertisements: rather than staging an expensive photo shoot in an exotic climate, many advertisers are compositing their products onto stock photos.

Compositing Concepts

DesignPaint and VideoPaint can be used to composite images. Consider compositing as a layering process, where layers of images are added together to create a final image. You can composite three different ways: you can add an image **over** another image, **under** it, or **atop** it.

How do these three differ? Imagine a simple situation, where you have an image of a white circle and are compositing a black circle into the image:



Creating textures

Texture maps play an important role in creating a finished rendered image. Any time that you want an object to have some variations in the surface appearance, be they differences in color, smoothness, transparency, or luminance, you can use a texture map instead of

creating the variations with different pieces. Textures are also used to create labels on products.

Texture maps are square, and they are a specific size. VideoPaint gives you 512 pixel square canvases to work with. DesignPaint gives you two of the most common sizes as prepared canvases. You can create other sizes as you need them with DesignPaint's capabilities for creating a canvas of almost any dimensions.

You can easily create colored textures, labels, reflection maps, and more. And creating 8-bit (black and white) textures is easy, too. You can either convert a color image to black and white in ALIAS, or create the texture map using the mask layer.

Peripherals

The power of ALIAS is compounded when it is combined with other tools, for creating or passing on 3D data or 2D pictures.

Video Integration

Video Integration makes it simple and straightforward to create high quality videotapes of your animations for use wherever you have a video tape player, including customer or management presentations. It also allows you to capture existing video imagery to use as backgrounds or textures in your own design.

ALIAS supports a wide variety of analog and digital NTSC and PAL video input and output devices. The process of creating videotapes and capturing existing video images is simple, using one integrated menu interface.

Video Output

After an animation sequence has been rendered, the individual frames can be displayed on the screen and transferred sequentially to videotape. You may also transfer wireframe animations or images created with QuickShade™ or QuickRender™.

ALIAS can send pictures to analog or digital recording devices via systems such as: Androx, Lyon Lamb System I, and Abekas systems.

Video Input

ALIAS video integration sub-systems range from PC-AT based frame grabbers to disk-based digital component video recorders. ALIAS can accept any RGB video source as input.

ALIAS will accept video images via: VideoFramer, Androx, Lyon Lamb Abekas , Dubner DPS1, and AVA.

Color Hardcopy

ALIAS provides the links that connect your system to the type of printer that best suits your needs. In accordance with your requirements, ALIAS will output to

high-speed, draft quality color printers, photo quality ink jet printers, and full color, high resolution film camera systems.

ALIAS currently supports the following color hard copy devices through an easy to use interface: Seiko D-Scan Printer, IRIS Graphics Printer, Kodak Digital Continuous Tone Printer, and Matrix Series Film Recorders.

As an alternative, ALIAS picture file descriptions are available, to let you attach the specific printers that you require to your ALIAS system.

Image Scanning

Scanning with ALIAS allows you to easily combine your three dimensional designs with existing full color, hard copy sketches and photos, thereby bringing realistic textures and backgrounds to your work.

ALIAS scanning is as simple to operate as a photocopier. This means that it is easy to capture and present real world environments and lifelike textures, thereby enhancing the effectiveness of your design.

ALIAS interfaces with the Howtek print and slide scanners through an easy to use integrated interface. Choosing the options from this interface accesses the various image enhancing options available on the Howtek scanner.

Plotting

ALIAS supports a variety of plotters for automatically outputting precision line drawings of all sizes. The ALIAS user interface makes it easy to produce complex and precise line drawings quickly.

ALIAS software converts your wireframe drawings to the appropriate language: Postscript™ for Postscript™ laser printers and HPGL for Hewlett-Packard plotters. It also allows you to control the orientation of your design in the hard copy output. Your model can be plot-

ted from any view: front, right, top, or any perspective. Cross sections are also available.

You can define the scaling of your design as it will be output. Scaling may be absolute (e.g. one inch on paper representing exactly one foot in real world terms) or relative (the drawing is proportionally scaled relative to the size of the plotter).

Film ALIAS allows to you easily capture your computer-generated designs on film. The Matrix Quick Color Recorder (QCR) and PCR receive files of image data directly from your ALIAS workstation, and produce high resolution photographic slides and prints.

Stereo Viewing Stereo Viewing is done in conjunction with the 3Display package from StereoGraphics Inc. This option consists of both hardware and software.

Software ALIAS Stereo Viewing generates a separate image for each eye. The 3Display system hardware visually blends the static stereo images rendered with ALIAS into full color objects with depth and perspective.

Because stereo pairs can be created during the normal rendering process, it is very easy to create a stereo image. All that is required is a simple change in the Scene Description Language (SDL) input to the renderer.

Hardware The 3Display system consists of a display controller, a large liquid crystal modulator, and a pair of passive polarized glasses. The liquid crystal modulator (the ZScreen) fits on the face of your color display, directing the appropriate left and right views to your eyes with the aid of passive polarizing glasses. The glasses ensure that you view stereo pairs as a realistic, full color, three-dimensional image.

Stereo-Lithography

Stereolithography allows you to turn your design into an actual physical model without expensive conventional tooling.

Stereolithography works through a combination of polymer chemistry, lasers, and computer-aided design. It gives you fast and precise physical plastic prototypes as end results. ALIAS also provides you with scaling options, based on a percentage of the stereolithography vat size, or scaled to an absolute ratio of model to real world units.

Making The Most of ALIAS Documentation

When you take delivery of your ALIAS, you will receive a complete set of manuals that explains every operation of the ALIAS system.

These manuals lead you on a tour of the package, and take you from the basic tools of the interactive package right through to the advanced programming techniques that can be used with Alias's Scene Description Language™ (SDL™).

ALIAS documentation forms a complete foundation for your ALIAS system, and you'll find it worth your while to familiarize yourself with it before going into a training session with members of Alias Assist at the Alias training facilities.

Alias Assist serves you in three different ways: with courses and training manuals, consulting, and a HotLine that you can call when you have problems.

The manual set is also useful for periodic review and troubleshooting after you have been using ALIAS for a while.

Packaged in a set of three binders, you'll get the following manuals: a User's Guide, Reference Manual, and Programming Manual.

User's Guide

The User's Guide is a set of tutorials that take you through some of the basics of ALIAS. By following the tutorials, you'll learn how to use the tools that ALIAS makes available to you. The User's Guide consists of a series of projects that teach you how to make models, apply surfaces, do texture mapping, animate objects, and use the mass properties functions, among others. It's a "How To" book.

Reference Manual

The reference manual is designed to provide the technical information that you need to operate every function of ALIAS. It is not a tutorial but a presentation and explanation of each button and its utilities.

This manual is divided into sections matching the sequence of major operations within ALIAS. The sections are divided into subsections that correspond exactly to the buttons as they appear in each menu level from left to right, and in the pop up menus, from bottom to top. It's easy to find out how a button works.

In addition to the button, pop up, and option box descriptions, the Reference Manual also includes explanations and usage of the stand-alone programs that are included in the package, as well as a glossary and index.

Programming Manual

When you want to delve deeper into ALIAS and access its advanced rendering capabilities, the Programming Manual gives you the tools to understand and edit the Scene Description Language™ (SDL™) file that the ALIAS renderers use. By editing this file, you can create custom effects and use procedural animations that are not available in the interactive package. The Programming manual is divided into two sections: Reference and Tutorials. These sections are similar to the Reference Manual and the User's Guide. In addition, you'll receive an SDL™ Quick Reference Card,

which will give you a speedy way of checking syntax once you have become familiar with SDL™.

Reference Section

The Reference Section is similar to a dictionary: you'll find definitions of syntax and variables in this section. Unlike a dictionary, however, it is not in alphabetical order: syntax is given in the order that it is likely to appear in the Scene Description Language file, and ordered by the sections in SDL™.

Tutorials Section

Tutorials are provided with the Programming Manual to help you use Scene Description Language™ effectively.

They start with the basics, as in "How to Edit a File," and work through a number of useful techniques. In addition to tutorials that teach you how to do some basic manipulations with the files, there are also a number of tutorials on procedural animation. With them, you can learn how to use dynamics and other physical principles to give added realism to your animations.

Quick Reference Card

The SDL™ Quick Reference Guide is a handy tool to keep by your computer terminal. If you're editing an SDL™ file, you may find it handy to know what the different variables are, and which section of the SDL™ file they fit into.

So You Want to Learn More...

Concepts in Computer Graphics:

Computer Graphics User's Guide. Glassner, Andrew S. Howard W. Sams & Co., Inc., Indianapolis, Indiana. 1984.

An Introduction to Ray Tracing. Glassner, Andrew S. Editor. Academic Press, San Diego, CA 92101. 1989.

Using the Operating System:

Introducing the Unix System. McGilton, H. and R. Morgan. McGraw-Hill, New York, NY. 1983.

The Unix C Shell Field Guide. Anderson, G. and P. Anderson. Prentice-Hall, Englewood Cliffs, NJ 07632. 1986.

Tutorial and Selected Readings in Interactive Computer Graphics. Freeman, H. IEEE Computer Society Press, Silver Spring, MD 20910. 1980.

Computer Graphics Programming:

Fundamentals of Interactive Computer Graphics. Foley, J.D. and A. Van Dam, in "Addison-Wesley Systems Programming Series". 1982.

"Computer Graphics" (Quarterly report of ACM/SIGGRAPH). Baltimore, MD.

"Computer Graphics and Applications" (IEEE Publication).

Procedural Elements for Computer Graphics.
Rogers, David F. McGraw-Hill, Inc.., New York, NY.
1985.

Mathematical Elements for Computer Graphics.
Rogers, David F. McGraw-Hill Inc., New York, NY.
1976.

Food for the Right Brain:

William Gibson: NEUROMANCER, COUNT ZERO, MONA LISA OVERDRIVE, BURNING CHROME

Ridley Scott: BLADERUNNER.

Glossary of Terms

Algorithm A rule or procedure for solving a mathematical problem that frequently involves the repetition of an operation.

ALIAS™ The name of the Alias Research Inc. software system for modeling, animation, painting and rendering, with connections to peripheral input and output devices. Also the name of the main menu level in that system.

Animation The process of creating and recording images that change over time. Though often interpreted as implying only two-dimensional image changes, it may be applied to any model or scene changes in three dimensions as well.

Anti-aliasing A group of methods for avoiding unwanted visual effects due to limited display resolution. These effects include staircasing along diagonal lines, moire effects in checkerboards, and temporal aliasing (strobing) in animated scenes.

Aspect ratio The ratio of width to height of a rectangular area, such as a window, viewport, pixel, or CRT.

Attributes Qualities or characteristics that affect the visual representation of surfaces, for example: color, eccentricity, specularity, and texture(s).

Bit mapping A technique for creating a graphics display by describing it in terms of pixels. (See raster graphics).

Bitpad A two-dimensional input device, consisting of a sensing surface (pad), and a pointing device (pen or puck).

Blinn shading A method of computing the shading of three-dimensional surfaces, developed by James Blinn. It uses four characteristics: **Diffusion**, **Specularity**, **Eccentricity** and **Refractive Index**.

Bump mapping A rendering technique that simulates bumpy surfaces. A technique for creating a surface texture on a three-dimensional object by wrapping a two-dimensional matrix of normals onto its surface. The matrix may or may not be random.

Button One of up to 16 operations available in a menu level.

CAD Computer Aided Design. The method of designing electrical and mechanical devices, components, and systems using computer systems. CAD typically makes extensive use of computer graphics.

Camera A position from which a scene is viewed. A camera is described by a combination of its position, viewing direction, rotation, and field of view.

Click To press and release the mouse button, once.

Clipping Removing the parts of the graphic image that are outside defined boundaries.

Column A vertical portion of a matrix or spreadsheet. Used in the animation dope sheet to define several aspects of one or more items (such as its scale or position) at each frame. Each column in a dope sheet controls the actions of an item or set of items over time. By contrast,

each **row** in the dope sheet describes the entire scene at one instant in time (frame).

Composite An image formed by combining two or more images.

Configuration The selection of various basic settings in the user interface, used to determine things like the coordinate system and what hardware (scanners, plotters, video systems) is enabled for use.

Confirm box A box that appears when a choice must be made, or an error or other condition must be acknowledged. A confirm box contains an explanatory message and one or more selections.

Control vertex (CV) A point that controls the shape of a curve or surface (see spline).

Coordinate system A method of describing the placement of a point in some space. In computer graphics, there are several coordinate systems, each one holding the values for the picture at some stage of the graphics pipelines.

Cursor An arrow or other shape showing the current location of the pointing device.

Curve A connected sequence of straight or curved lines.

Data files User-generated and user-saved files from painting, modeling, rendering, animation, filming, and printing.

Default The initial setting of a menu, pop-up, or function. The setting you get when you first start using the system.

Diffusion A measure of the diffuse component of the light reflected from the surface of an object. The diffuse component carries the color of the surface; the specular component appears as highlights.

Dolly To move the camera forward (dolly in) or backward (dolly out).

Dope sheet A two-dimensional spreadsheet used to lay out an animated sequence. Each column describes the actions of one item or group of items. Each row represents one frame in the animation.

DXF™ Drawing Exchange File is a file format developed by Autodesk, Inc. for the exchange of geometric and drawing information between microCAD systems.

Eccentricity A way of describing and controlling the size of highlights on an object, when using the Blinn shading model.

Edit Point A point that controls the shape of a curve or surface and is placed directly on the spline.

Extrude To make a three-dimensional surface or shape, by sweeping a curve or face through space. The extrusion will have the curve or face as its cross-section.

Face A closed curve that defines a surface. A face may have holes in it. Extruding a face allows you to have faces at either end of the extrusion.

Fractals A class of shapes that exist in fractal or non-integer dimensions, created by fractal geometry, which applies recursive subdivision to a basic form while introducing a random factor at each subdivision.

Frame Buffer Memory used for storing the picture for screen refresh.

Gamma correction A process of adjusting light intensities in a display device (video or film) to achieve correct apparent brightness or colors.

Grab To capture a frame of video or film, and store it in digital form.

Grid A cross-hatched pattern in the **MODEL** level that provides a visual reference.

Hermite A type of spline curve that passes through the control points. Hermite curves are used in **Animation** for specifying motion paths.

Hidden Surfaces Surfaces that are obscured from view in the current rendering of the object.

Hierarchical database A graphics database that defines the parts of a scene in relationship to each other such that the movement of one part is dependent on or independent of movement of another part.

Hull A network of lines that join the control vertices of a curve or surface. The hull shows the relationship between two CVs beside one another. When working with b-splines, the hull of a closed curve is larger than, and surrounds, the curve.

HSL Hue, Saturation, and Luminance. Three components of the HSL color model. Hue describes the color (red, yellow, etc.); saturation describes the amount of white mixed in (red vs. pink), and luminance describes the overall brightness of the color.

IBM RS/6000 The IBM RISC workstation.

IGES™ Initial Graphics Exchange Specification. A file format for transferring graphics data between computer systems.

In-betweening Computerized interpolation between key frames of an animation sequence.

IRIS™ (Trademark of Silicon Graphics, Inc.) **I**ntegrated **R**aster **I**maging **S**ystem. The name of a workstation family on which the ALIAS software system runs.

Keyframe The state (size, location, etc.) of an item, at a point in time is specified by a keyframe in an animation. In-between frames are created by the system.

Light A source of illumination in the three-dimensional model. A light can be assigned an intensity, color, position, etc.

Light, Ambient A lighting model that produces a constant illumination on all surfaces, regardless of their orientations. A red ball looks like a red circle if there are no highlights or shading to indicate depth.

Light, Directional Light from a point light source located at infinity in the user's world coordinates. The rays from the source are parallel, and the direction of light is the same for all objects, regardless of their position.

Light, Positional Light from a point light source located relatively close to the viewing area. Rays from this type of light source are not parallel, and the position of the object with respect to the light source affects the angle at which light strikes the object.

Mask In **DesignPaint**, a mask overlay is used to partially or completely prevent painting over an area of the image. The mask can be edited, like the image. A mask can be used to selectively restrict file input operations.

Matte Like mask, but a matte defines the areas of an image to which file input operations are to occur.

Modeling Coordinates A coordinate system used in computer graphics that is used to represent an object in terms you define. For

example, a car might be defined in terms of feet. Also known as world coordinates.

Motion path A three-dimensional curve which defines the x, y, z position of an item during an animation.

Mouse Hand held input device used for pointing on screen. Used in conjunction with a tablet.

Normal The orientation of a surface; that is, the direction the surface faces.

NTSC National Television System Committee. The body responsible for the video signal standard in North America.

NURBS NURBS (Non-Uniform Rational B-Splines) are a special type of B-spline, in which you can have weighted control points. NURBS create smooth curves that are readable into the ALIAS system from many CAD/CAM systems.

Object Primitives, text, lights, patches, or other items.

Orthographic view A parallel projection from one side (top, front or right views), such that a depth cannot be perceived.

PAL Phase Alternate Line. The video signal standard used in Western Europe and the United Kingdom.

Palette A matrix of colors in the **DesignPaint** and **ALIAS** programs.

Parameter curve A curve that maps the value of an animation parameter (the scale, rotation, or translation) versus time.

Parametric surface patches Entities used to define a three-dimensional object, which are created with a limited number of control points defining the surface's shape and curve, with the

remaining points determined computationally. Also known as bicubic patches.

Patch A linear interpolation between two curves for producing a three-dimensional free-form surface.

Path (animation) The trail along which an object is animated.

Pathname (UNIX) The name of the file in the UNIX file system (on disk). Pathnames begin with the slash character "/" to signify the top or root of the file system.

Phong shading A method of shading the surfaces of three-dimensional surfaces developed by Phong Biu-Tuong. The Phong model uses three characteristics: **Diffusion**, **Specularity**, and **Shininess**, to create a smoothly curving surface with light-reflecting highlights.

Pix (file) A picture file used by **DesignPaint** and produced by the raycaster or quick renderer.

Pixel A blending of the words "picture element". A discrete unit of picture information, the smallest unit of raster graphics. The smallest element of a display surface that can be independently assigned a color.

Primitive One of the basic geometric building blocks of object modeling (sphere, cube, cone, etc.) built into the ALIAS System.

QuickRender™ A limited quality, high speed method of adding surfaces and lights to objects, usually for testing their appearance before rendering.

QuickShade™ A high speed hardware rendering of surfaces and lights that permits the user to rotate, scale, and/or translate objects in near real time.

RayCasting™ A technique for rendering scenes in computer graphics. The casting of non-bouncing rays from the eye to the object.

RayTracing™ A method for tracing the path of light rays from their source to the viewer's eye as they reflect from and/or pass through the objects (like water or glass) that make up a scene.

Reflection In computer graphics, a surface characteristic used to determine color intensity in lighting models, which therefore helps determine how the surface looks.

Rendering The process of creating finished output from a software scene description. The process of producing images or pictures. Rendering techniques such as shading, light sourcing, or depth cueing are sometimes used to make the image look realistic.

Resolution The maximum number of displayable pixels in the horizontal and vertical directions. Also the number of pixels per inch.

RGB Red, green, and blue. Three additive color components used to create any color by mixing.

Scaling The changing of the size of an object, without changing its location or orientation.

Scene Block Diagram(SBD) A diagram depicting the hierarchical structure used to represent the objects and sub-objects in modeling. The SBD window displays the structure of a scene. Things can be picked in the SBD window, just as they can in the geometric windows.

Scene A collection of objects, either in wireframe form or rendered.

Scene Description Language™ (SDL)™ Used to control all coloring and lighting attributes of all rendered scenes and animations. SDL files are gen-

erated by the renderer and can be hand-edited for greater control of the final rendered images.

Shading The difference in color across a surface due to different surface characteristics and lighting.

Shading model The algorithm used to create the intensity and color of the visible portions of a scene. The shading model usually incorporates the surface normal information, the surface reflectance attributes, and the lighting model. Also called a **Shader**.

Shadow An area that is totally or partially obscured from light by an object. In computer graphics, ray tracing and ray casting are two illumination models that can create realistic images.

Skin A surface that fits across a number of cross-sectionals.

Smooth shading The process of smoothing the polygonal edges of a model to make it appear realistically three-dimensional. See also Blinn, Phong, and Diffuse shading.

Specular reflection The type of reflection that happens when light hits a shiny surface. It causes highlights on the object.

Spline A curved line, made up of segments and defined by control vertices (CVs). Includes polylines, cardinal splines, b-splines, and non-uniform rational b-splines (NURBS).

Surface A two-dimensional shape that defines the boundary, or surface of an object. The shape may be flat or warped. Examples of surfaces are patches and faces.

Surface normal The vector that is perpendicular to the polygon surface. Surface normals are used in calculating surface shading.

Tablet The small rectangular surface upon which a mouse rests.

Tangent A tangent vector is used to determine the slope of a curve at a given point.

Template An object can be made into a template, for use as a background drawing or modeling reference (the way a grid is used). The template remains visible, but cannot be picked as an object (it is protected). A template can also be turned back into an object.

Texture mapping An algorithm for "wrapping" a two-dimensional pattern or texture around the surface of a three-dimensional object so that the pattern curves and distorts realistically.

Timing curve The timing curve graphs the percentage of the total length of the motion path travelled versus time. It is used to position the in-between frames along the path. Each object in an animation that has a motion path also has a timing curve.

Transform To rotate, scale, and/or translate a graphical object.

Translation The changing of position of an object without changing its shape, size, or orientation. All points in a translated object undergo a linear displacement.

UNIX™ (Trademark of AT&T/Bell Laboratories.) The operating system under which the ALIAS program runs.

VDA(FS)™ VDA Surface Interface is a standard file format designed by European auto manufacturers for the exchange of geometric information between CAD systems.

Vertex Normal The vector coming from the vertex of a polygon: often an average of the normals from all adjoining surfaces.

Vertex normals are used in calculating surface shading. Compare to Surface Normal.

Wireframe An image made up of the edges of objects, and drawn as lines. It resembles a model made of wire. Objects are displayed as wireframes in the modeler. A method of model construction that produces objects defined by a network of straight lines, characteristic of vector-based systems. The drawing of a model by tracing features such as edges or contour lines without attempting to remove invisible or hidden parts, or to fill surfaces.

World The entire collection of objects which exist as wireframes in the current working environment.

World Space A coordinate system used in computer graphics that is used to represent an object in terms you define. For example, a car might be defined in terms of feet. Also known as *modeling coordinates*.

Xform Transform. The transformation of control vertices, curves, or objects by moving, scaling, rotating, extruding, revolving, or patching.

Appendix:

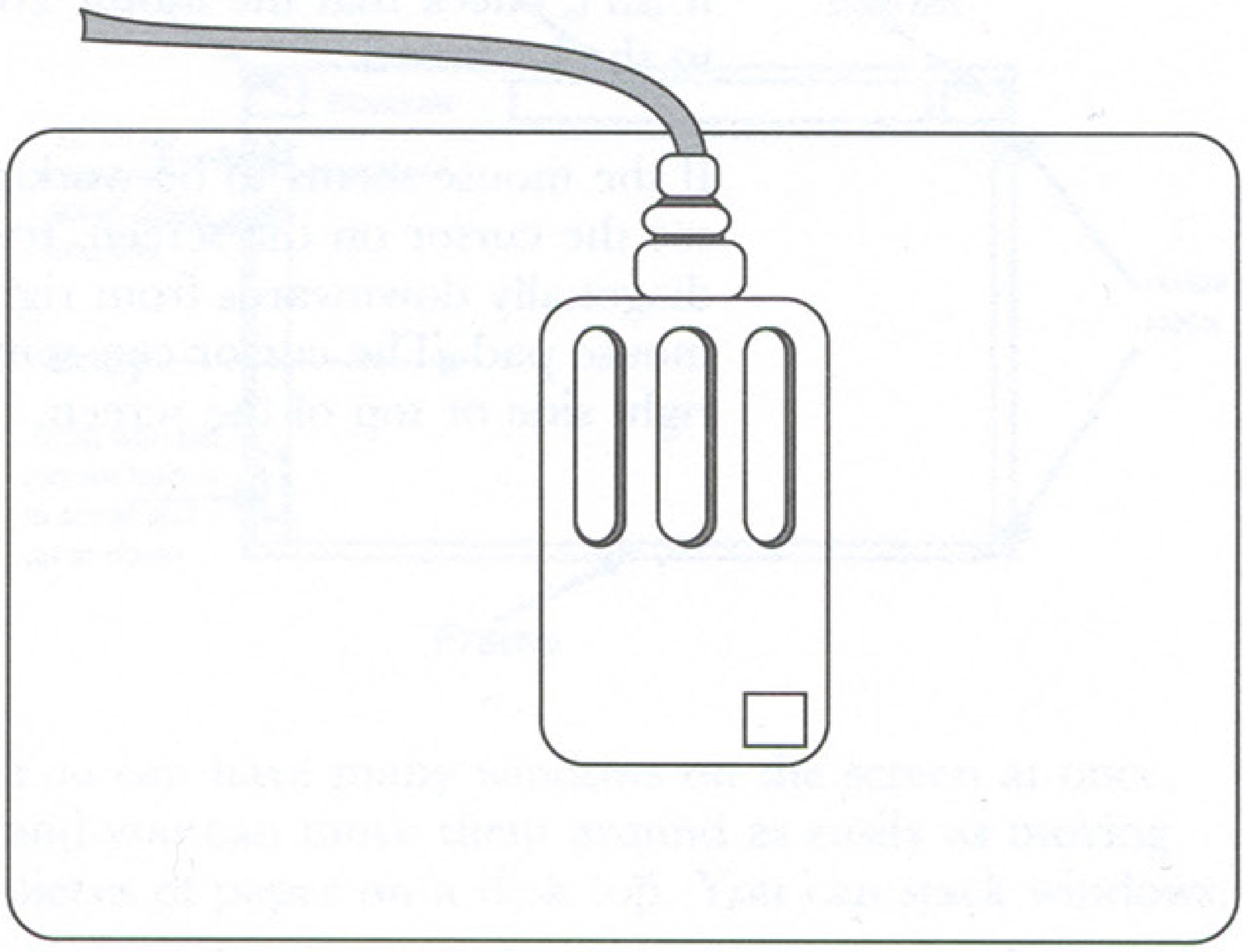
Logging On for the First Time

Mousing Around

The ALIAS system comes equipped with an optical or mechanical mouse, which makes it as easy to perform operations within ALIAS as sketching on a piece of paper.

Your Mouse

If you have an optical mouse, it should rest on its metallic pad at all times like this:



If the mouse is not on its pad, the system will not notice its movements. Make sure the long side of the metallic pad is placed horizontally, so the computer will understand what you are doing with the mouse. When you use the mouse, your fingers should be over (but not yet pressing) the three buttons.

The cursor

The position of the mouse is indicated on the monitor screen by a small red arrow called the *cursor*. When you move the mouse on the pad, the cursor will move in the same path on the monitor.

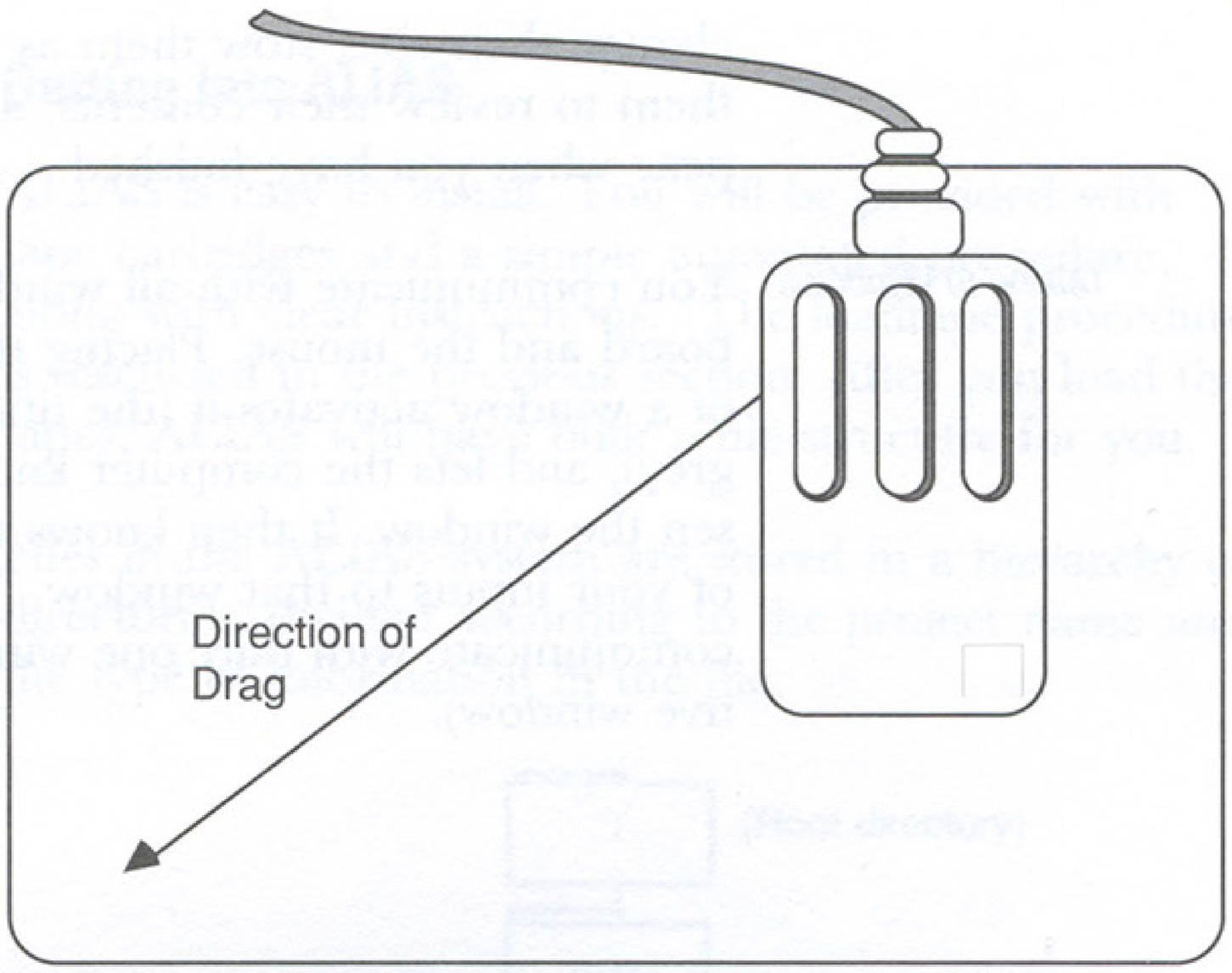
Mouse Operation

There are two basic operations you perform with the mouse: *clicking* and *dragging*. Clicking is the act of depressing a mouse button and releasing it immediately. Dragging is the act of pressing a mouse button, moving the mouse so that the cursor is positioned where you want it, and then releasing the mouse button.

Mouse Trouble

Checking that the mouse is working is easy. Just turn the mouse upside down and see if the red light is on. If it isn't, check that the mouse cord is firmly connected to the keyboard.

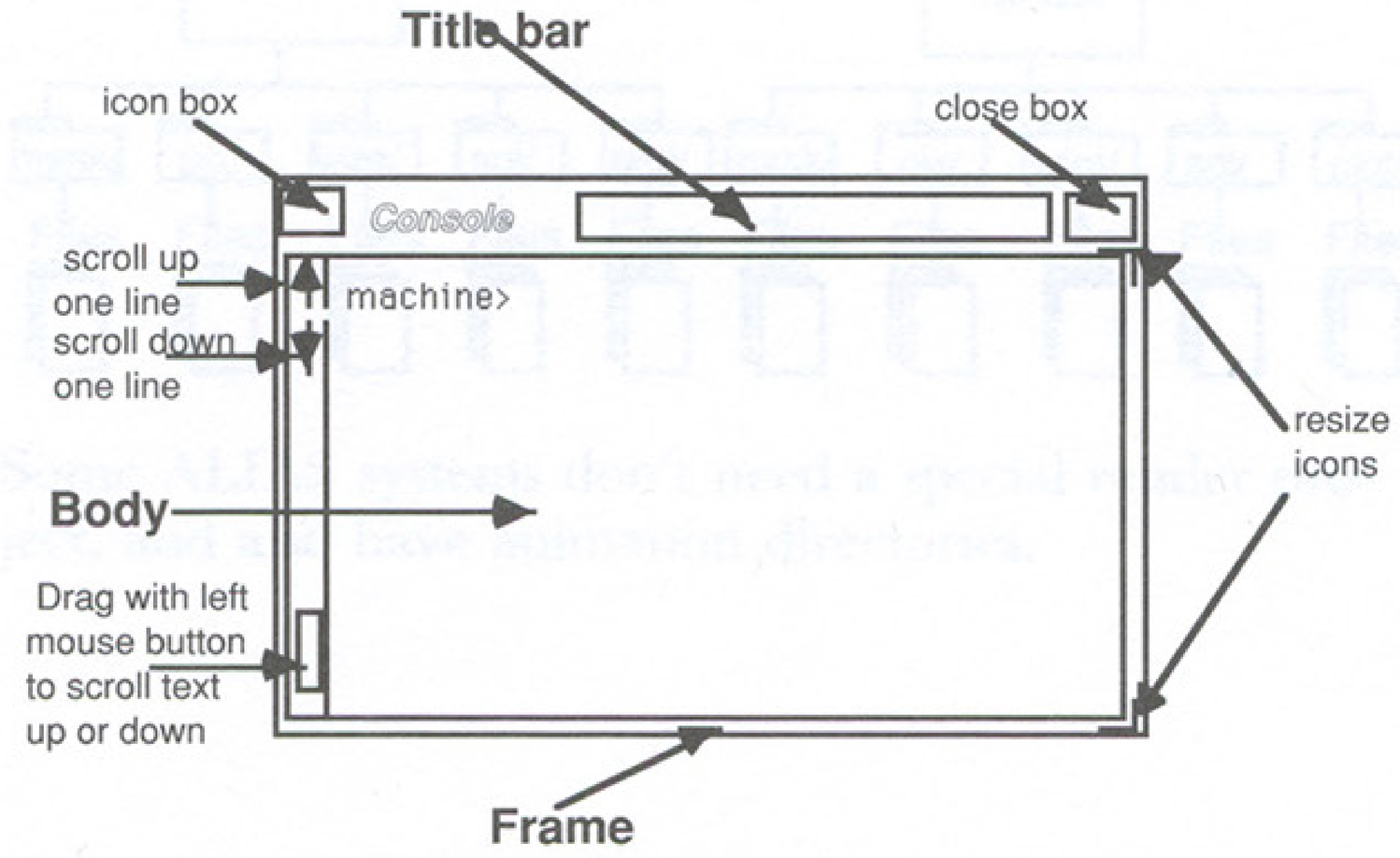
If the mouse seems to be working but you still don't see the cursor on the screen, try dragging the mouse diagonally downwards from right to left across the mouse pad. The cursor can sometimes drift off the right side or top of the screen.



Note, however, that the cursor may also disappear when the system is working on certain operations.

Windows

Logging into the system will open what is called a *window* on the screen. Every window has three components: the body, the frame, and the title bar.



You can have many windows on the screen at once, and you can move them around as easily as moving pieces of paper on a desk top. You can stack windows,

change their size, stow them as icons, scroll through them to review their contents, and make them disappear when you have finished.

Talking to Windows

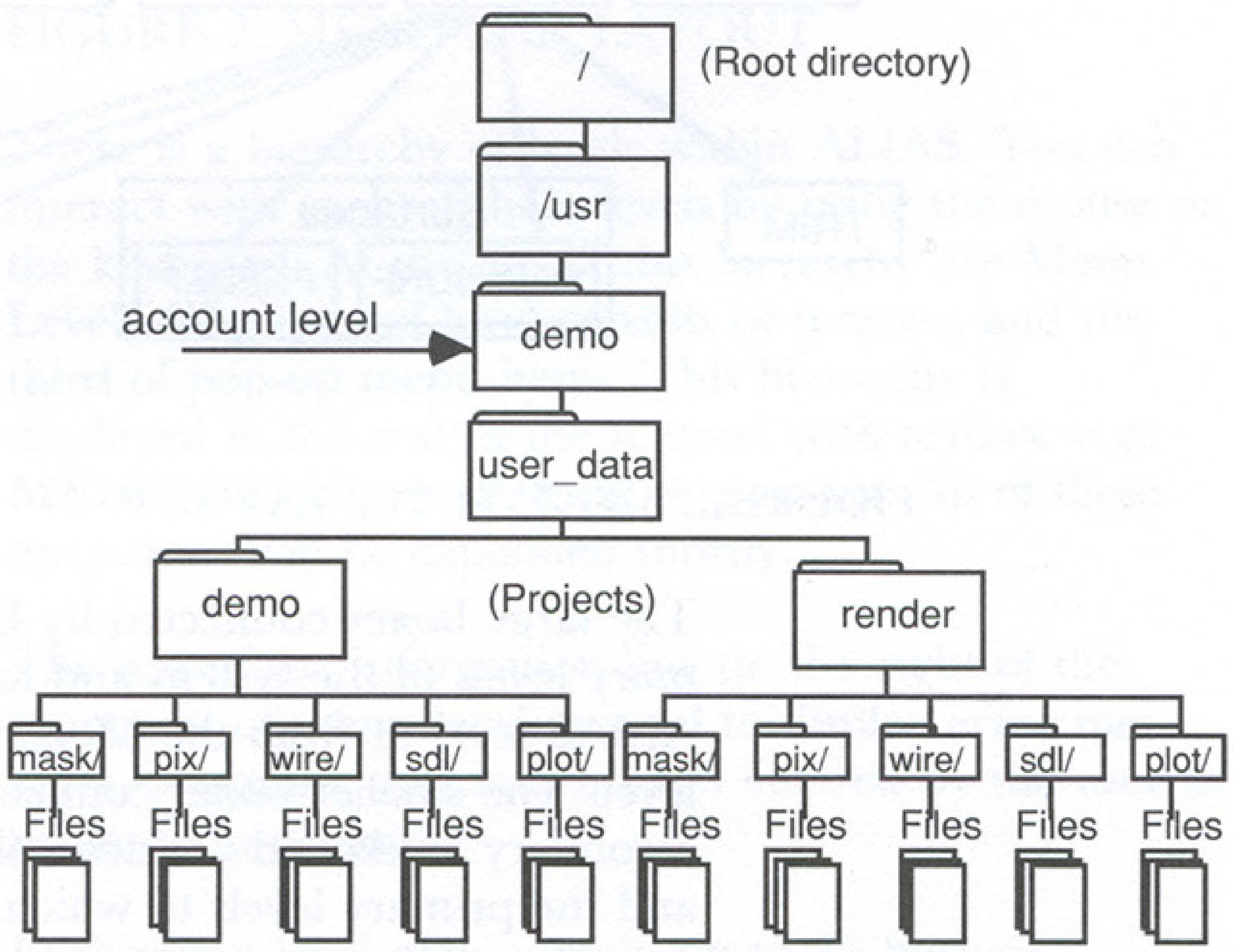
You communicate with all windows through the keyboard and the mouse. Placing the cursor over the body of a window activates it (the title bar turns a darker grey), and lets the computer know that you have chosen the window. It then knows that it should direct all of your inputs to that window. Note that you can communicate with only one window at a time (the active window).

Getting Into ALIAS

ALIAS is easy to install. You will be provided with tape cartridges and a simple automated procedure, along with clear instructions. The loadtape procedure is discussed in the previous section. After you load the tapes, ALIAS will have built a file structure for you.

The Alias File Structure

Files in the ALIAS system are stored in a hierarchy of directories, divided according to the project name and the type of information in the file:



Some ALIAS systems don't need a special render project, and also have animation directories.

Starting Up

System Layout

ALIAS consists of three main **menu levels**. Each level corresponds to a major functional division of the system. Some ALIAS systems have Animation on the primary level, and also have a Print primary level.

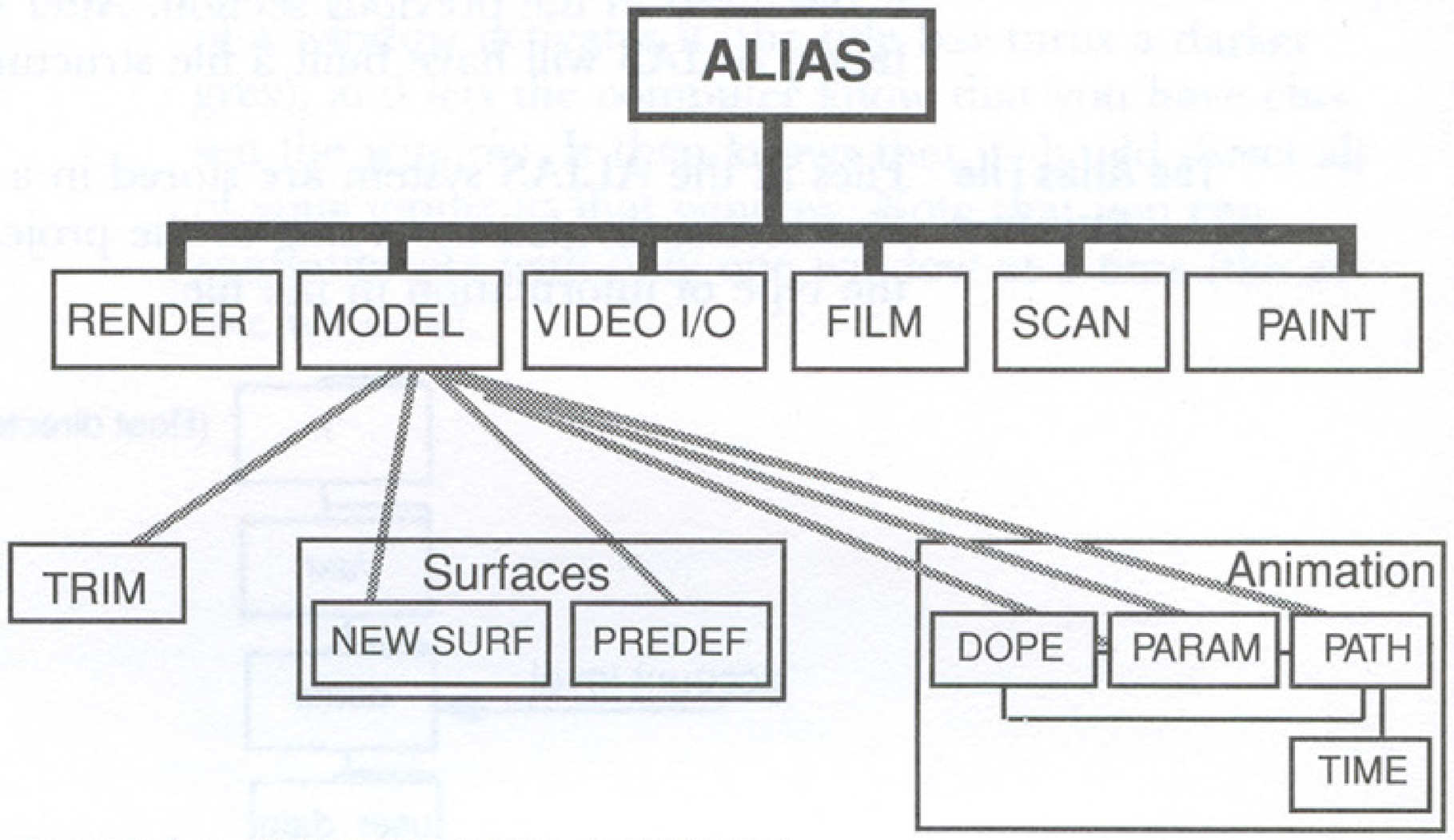


FIGURE 1: MENU LEVEL LAYOUT

The large boxes connected by black lines are the primary levels of the system and are accessible from the ALIAS level or from the Menu button of any primary level. The smaller boxes connected by grey lines are secondary levels and are accessible through the system and the primary levels to which they are connected.

Menu Levels

The name of each menu level appears in the left-most position in the information line of the menu bar. This tells you where you are — that is, what level you're working in; for example, MODEL.

A menu bar consists of the following:

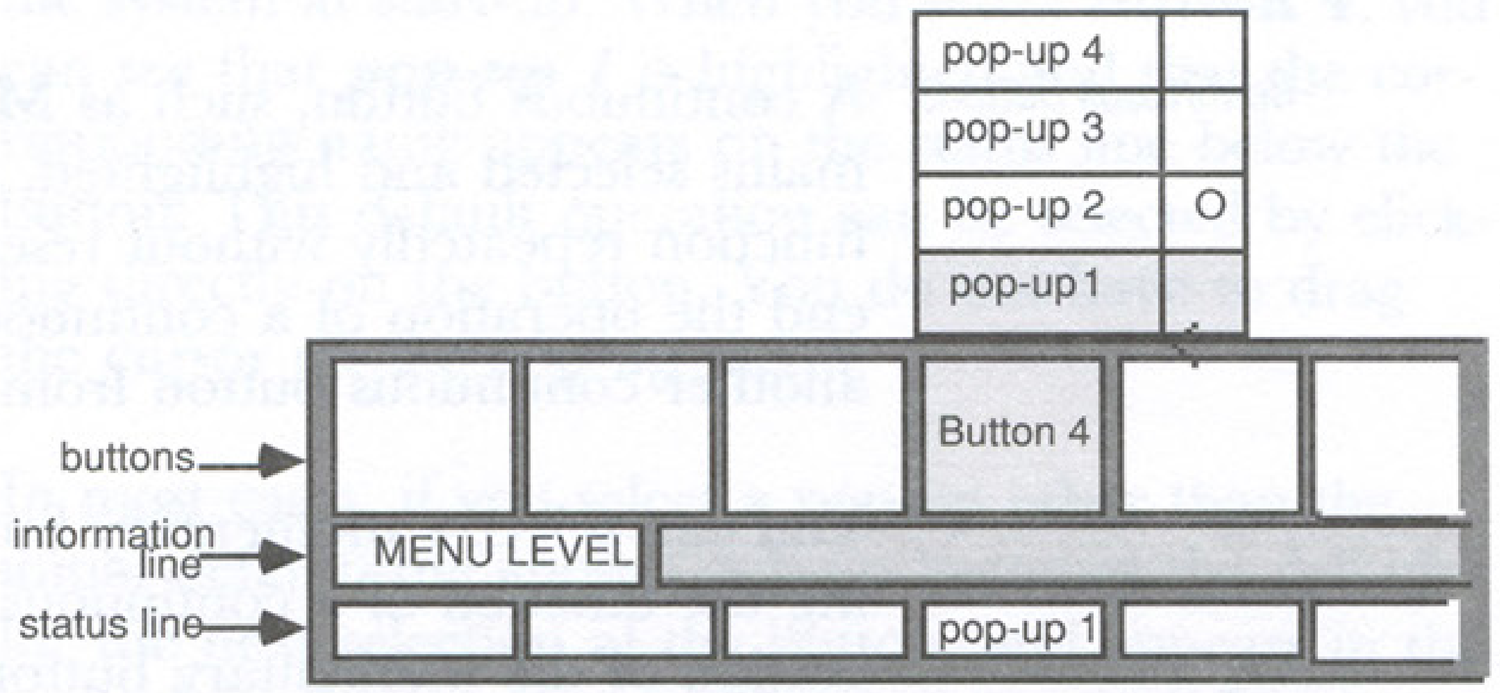


FIGURE 2: MENU BAR LAYOUT

Notation

There is a hierarchy of levels within ALIAS. You can interact with each of these levels by using the mouse or the keyboard. At the top of this hierarchy are Menu Levels. The second level consists of buttons, and the third of pop-up menu items. This hierarchy is displayed in the text of the manual with arrows. e.g.: **MENU LEVEL → Button → *pop-up***. All of these operations will be explained shortly.

Information Line

The rest of the information line (to the right of the statement of menu level) is used to display error messages, warnings, and information entered by the user in response to prompts.

Buttons

Each menu level may contain up to 16 buttons. Buttons are presented in ALIAS manuals in mixed case bold characters, and may be preceded by the menu level and an arrow. For example, to refer to the **File** button in the **MODEL** level, the notation **MODEL → File** is used.

Momentary Buttons

Although all buttons look alike, there are actually two types of buttons: continuous and momentary. Momentary buttons, such as **MODEL → Wind**, perform an operation once for every time you select the button. Once the selected operation has been executed,

the button is automatically deselected and the highlight disappears.

Continuous Buttons

A continuous button, such as **MODEL → Pick**, remains selected and highlighted, allowing you to use the function repeatedly without reselecting the button. To end the operation of a continuous button, just select another continuous button from the menu.

You can select a momentary button without interrupting the function of a continuous button. When the operation of the momentary button is finished, the system reverts to the operation of the last continuous button. For example, if you select **Pick**, and after a few operations want to show your scene in another window, select **Wind**. Once the **Wind** operation is performed, you will automatically continue in the **Pick** operation without reselecting it.

Pop-Up Menus

In many cases, when you select a button, a pop-up menu appears above the button, allowing you to choose one of the pop-ups. These are used to make your chosen operation (button) more specific. For example, instead of simply choosing **Pick**, you can specify that you want to pick an object, or a component of an object. To choose a pop-up, keep the mouse button depressed, move the cursor upward to select the desired operation, and then release the mouse button.

Pop-ups are presented in ALIAS manuals in lowercase italic bold text, preceded by the button name and an arrow. For example, the pop-up ***retrieve*** in the pop-up menu above the **File** button is referred to as **File → *retrieve***.

Status Line

The status line at the bottom of the screen shows the current default of each button: i.e., it displays the pop-up that would be automatically selected when you press the button. In most cases, the initial default is the operation displayed at the bottom of the pop-up menu.

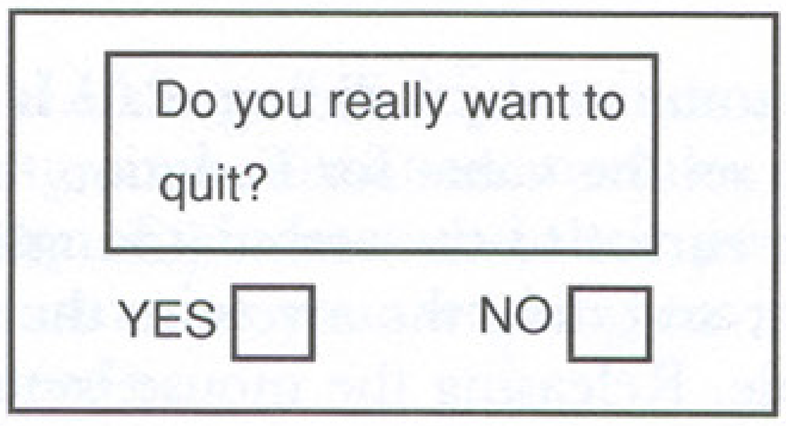
In FIGURE 2, ***pop-up 1*** is the initial default, set by the system at start-up. When you select **Button 4**, you can see that ***pop-up 1*** is highlighted and that the corresponding name appears on the status line below the button. This default operation can be selected by clicking directly on the button. You do not have to drag the cursor up the pop-up menu.

In most cases, if you select a pop-up other than the initial default, the chosen pop-up becomes the default for the next selection of the button, and appears in the status line. In certain cases, however, especially where an inadvertently selected default may destroy data, the current default is reset to the initial default.

Note that in the actual system, menu levels, buttons, and pop-ups are named, rather than numbered, which makes it easy for you to tell exactly where you are.

Confirm Boxes

Certain operations that could result in undesirable actions if accidentally selected require confirmation from you before the computer will carry them out. For example, select **Menu → *exit*** from any menu and the following confirm box appears:



Click with the cursor on **YES** to continue with the action., or enter 'y' from the keyboard. Click the cursor on **NO** to cancel the operation, or type 'n'.

Option Boxes

In some cases, a pop-up may include a small box with the letter '**O**' (for option), as in ***pop-up 2*** **-O** in FIGURE 2. This indicates that you may view or change some options related to the operation of the pop-up. For example, in building primitive objects (**MODEL → Object → *prim* - O**), the options allow you to choose from among spheres, cubes, cones, etc. To view and change the options, drag the cursor up to

pop-up 2 , then move it across to the '**O**' and release the mouse button: an option box appears.

An option box may have some of the following elements:

Function 1	VALUE 1	VALUE 2	VALUE 3	VALUE 4
Function 2	ON		OFF	
Function 3	IGNORE		RESPECT	
Function 4	0 △ 50 100			0
Function 5	10.0			
Sample Options	Save	Exit	Go	

FIGURE 3: OPTION BOX LAYOUT

The left column contains the functions that may be set in the option box, and often includes the title of the option box.

In the option box above, you can set Function 1 to VALUE 1, VALUE 2, VALUE 3, or VALUE 4 by moving the cursor to the desired value and clicking any mouse button. For most operations, selecting one value automatically deselects all other values in that row.

Sliding Scale

In some cases, a sliding scale is used to set the value. To set the value for Function 4, above, you can move the cursor to the arrow (triangle), press any mouse button, and drag the arrow to the desired value on the scale. Releasing the mouse button when the cursor is outside the sliding scale resets the scale to its initial value.

The current value is shown in the scale box to the right of the sliding scale. You can also type in a number by moving the cursor to the scale box, clicking any mouse button and entering the desired value.

Field In some cases, a function's value may be changed by changing the numerical value in the section of the option box referred to as the *field*. To change the value for Function 5 above, move the cursor to the current value in the field, 10.0, and click a mouse button. A question mark or prompt appears. Enter the new value and press the carriage return.

Standard Operations

Option boxes always contain at least two of four standard operations: Save, Exit, Reset, and Go.

If you select **Save**, any changes made in the option box are saved for subsequent selections of the pop-up. However, the pop-up is not executed. Typically, you will set the values in several option boxes at the start of a work session, using **Save**.

Exit allows you to leave the option box without applying or saving the changes or executing the pop-up.

Reset changes any values that were modified, for whatever reason, back to their original default values.

Go executes the pop-up according to the current settings and saves them for subsequent selections.

Multiple Windows

ALIAS uses multiple windows in its modeling, rendering, and animation modules. You can change the number of windows and their position, size, and shape, to customize your working environment to best suit your needs.

Although you can view several windows at once, you can only work in one at a time. However, all the other windows will be automatically updated as you work. To pick a window (to work in it, or *make it active*), move the cursor over the window and click any mouse button. The window appears on top of any other windows of the same or lower priority that previously overlapped it. Three asterisks in the title bar at the top of the

window indicate that it is the active window (see Figure 4, below).

Manipulating Windows

When you are creating a scene, it is helpful to have the four standard application windows on the screen, in order to judge the relative position of items. However, sometimes you may want to enlarge one window to examine its view in greater detail. Or you may want to close some windows to shorten the time required to manipulate complex scenes.

You can perform four operations on any active window:

- move
- resize
- enlarge
- close

With some ALIAS systems, the window looks like this:

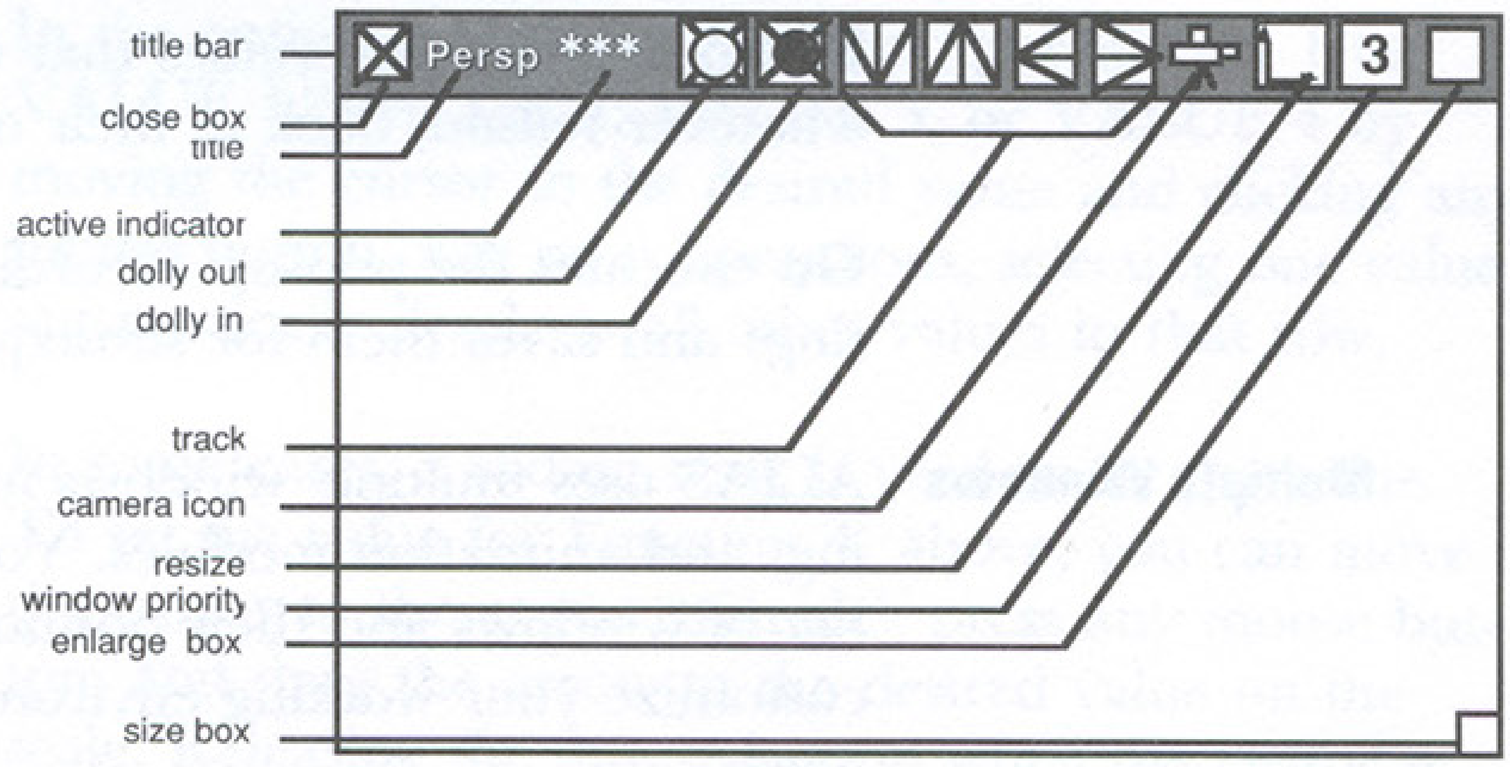


FIGURE 4: ALIAS APPLICATION WINDOW

Moving

To move a whole window without changing its size or shape, position the cursor on the title (or anywhere in the title bar at the top of the window) and drag it to its new position using the mouse.

Resizing

To change the size of your window, move the cursor to the size box, located at the bottom right corner of the

window. Drag the size box and an outline of the window follows your movements.

Enlarging

To fill the screen with a window, move the cursor to the enlarge box in the top right corner and click a mouse button.

To return the large window to its previous size and location, click on the enlarge box again.

Closing

To remove a window from the screen, move the cursor to the close box at the top left of the window and click any mouse button.

Opening New Windows

You can open several windows on the same view to examine a scene from many locations. Select **Wind → *new* - O** to create new windows.

Performing Operations Within An Active Window

In addition to performing operations on active windows, icons located on the title bar allow certain operations to be performed to or on the window without having to select a button from the menu bar. The user can manipulate his point of view (the *camera*) by tracking and dollying in or out without having to explicitly change modes by selecting the continuous **Views → *track*** or **Views → *dolly*** functions. These operations may be performed on the following types of windows:

- MODEL application (orthographic and perspective) windows
- SBD windows
- PARAM curve windows

The icons are as follows:

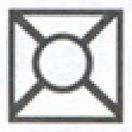
track horizontally to the right

track horizontally to the left

track vertically up

track vertically down

dolly in to the center of the window



dolly out from the center of the window

resize window

To use any one of these functions, select the appropriate icon. The icon image changes to show it has been selected. The corresponding function is performed until the mouse button is released. The buttons on the input device (mouse or puck) provide different speeds for the operation. On the mouse this corresponds to:

LEFT button:	SLOW
CENTER button:	MEDIUM
RIGHT button:	FAST

Note The resize window icon lets you QuickRender an image to exact dimensions. For further information about QuickRender, refer to the Rendering section of Chapter 2.

Window Dimensions		
size x y	638	450
offset x y	0	0

Size xy determines the window dimensions in pixels. The **offset xy** field determines the origin of the image. 0,0 is the lower left corner of the screen (immediately above the menu bar).

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